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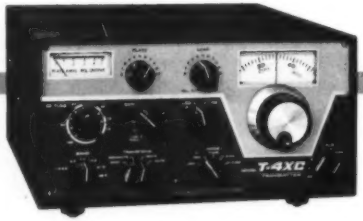

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for radio amateurs

#150 MARCH 1973

FEATURES

2 Never Say Die W2NSD/1
6 SSTV Scene
6 Mars
9 Repeater Update
11 DX Footnotes
12 AMSAT News
12 Hamburglar
12 50 MHz Band
15 Looking West
16 Report from Managua
107 The Travelling Ham
107 FCC News
110 Social Events & Contests
111 Ham Help
111 New Products
126 Caveat Emptor
160 Propagation

EDITORIAL STAFF
Wayne Green W2NSD/1
Keith Lamonica W7DXX/1
Ron Subka WA9FPP/1
Yvette Grimes WA8ULU/1

ASSOCIATES
Jim Kyle K5JKX
Mike Frye WB8LBP
Bill Turner WA8ABI
Jim Weir WB6BHI
Harry Simpson A4SCF
Dave Ingram K4TWJ
Bill Holsington K1CLL
Gus Browning W4BPD

PRODUCTION AND ADVERTISING
Philip Price
Lynn Panciera-Fraser
Ruthmary Davis
Bill Sundberg
Janet Oxley
Bill Suderman
Karen Hebert
Cynthia Schlosser
Biff Mahoney
Alexandra Schmidt

BUSINESS
Gigi Sage

CIRCULATION
Dorothy Gibson
Barbara Block
Ace Goodwin W1GRO
Ginger Pettee

TRANSPORTATION
Del Sanford

PROPAGATION
John Nelson

DRAFTING
R. K. Wildman W6MOG
Bill Morello
Wayne Peeler K4MVW
T. M. Graham W8FKW

20. A Fast Scan Facsimile System W6WMI
Use it with SSTV.
31. Six and Two Meter High Power K4EPI
Using a $25 surplus amplifier.
35. Solid State Repeater Control K2OAW
Timers, ID, etc.
45. A Digital Tape Distributor for RTTY K4EEO
Are you still using motors? Tsk.
50. The Ample Amplifier K9PYY
All band, 1200 watts.
55. Popular SSTV Circuits – Part II W9NTP
19 more slow scan circuits.
69. The Can Scanner K4TWJ
World's cheapest SSTV camera?
73. Improving the Indoor Antenna System W2EEY
Using copper foil.
77. Updating Sorenson "A" Nobatrons W6GXN
Low voltage power control.
81. FM Deviation Meters VE7ABK
Gay lib special.
85. Time Frequency Measuring System – Part III K5DUS
Counter.
97. Another Use for 400 Cycle Transformers W8NVM
Another use is badly needed.
101. Bandpass Filter Design WB6NWQ
An engineer's delight.

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EDITORIAL BY WAYNE GREEN

A NUDE COVER???

If plans go as expected, the next issue of 73 should be a landmark of sorts. You may have watched with interest (or dismay) as the lovelies on the 73 covers have gradually stripped down – wondering what was coming next.

Perhaps you knew, somewhere inside, that some day 73 would make the plunge and go all the way – not with a Playboy foldout, but with a nude right on the front cover. Well that is what is in the works.

Oh, it will be tasteful – the model's father, an old time ham, is helping with the project – and after all, it is amateur radio that is the main interest of the readers, right?

Once you get by the full nude cover of the next issue, you will find yourself immersed in FM – for this is our yearly FM issue. Non–FMers need not panic, for editor Subka has prepared a dandy bunch of other stuff too. That's one of the nice things about having so many articles in each issue. On the other hand, non-FMers would do well at this juncture to stop for a few moments and consider their attitude toward FM – about 50,000 amateurs agree wholeheertedly that FM is the biggest fun they've ever had in amateur radio – and while it is possible that they are all wrong, it is not likely.

The situation reminds me of the early days of television when many people kept telling each other that it wasn't any good – so they missed out on the fun until they finally bought a set. I was one of the early TV buyers and got to see all of the programs that are now remembered as historical landmarks – the halcyon days of television. I'm sure glad that I got into FM when I did – and I'm still enjoying. Tried it yet?

FCC CRITIZES ARRL

In the rejection of all comments filed on 19162, the phone band expansion docket, the FCC took the ARRL to task in no uncertain terms.

The FCC expresses the concept that amateurs should get more frequencies by upgrading their license and seems quite contemptuous of the ARRL's request for giving more frequencies to lower classes of licenses. Indeed, the FCC was most blunt about the fact that they intend to give more and more frequencies to the Extra Class licensees – as more amateurs get their Extra.

To quote: "Sub-band apportionments are determined by considering the number of individual licensees in each group having privileges to each sub-band, *weighted in favor of the higher classes.* (The emphasis is theirs.) Therefore, assuming the present upgrading pattern continues as we anticipate, there will be further expansion of the exclusive-frequency privileges for the Advanced and Amateur Extra Classes, and a corresponding reduction in the frequency privileges for General and Conditional Classes."

On the subject of the ARRL, the FCC has this illuminating bit to offer: "Insofar as is known, the ARRL has not initiated any recent major program to upgrade the status of the lower classes of licensees." They go on to say that, "Recent information, obtained from reexamination of certain Conditional Class licensees, indicates that probably a large percentage of that category of licensee does not meet the Commission's qualifications to occupy the high frequency bands . . ."

The Commission disposes of 18 different RM's with their blanket denial of relief in any aspect of 19162. It is difficult to accept that every single petition filed in response to 19162 was totally without merit, including the comprehensive one filed by ARRL. If, in fact, any did have merit, then the total denial of all petitions is certainly not in the amateur interest and would seem to indicate a dictatorial and arrogant attitude on the part of the Commission toward amateurs – and certainly it indicates that the Commission has no respect whatever for the opinions of amateurs – or perhaps for the amateur service.

If the Commission is to hold the respect of the amateurs it must give heed to petitions for relief, not the totally deaf ear. The recent pattern of ruthless suppression of all comments and pleas from the amateurs in the cases of dockets 18803 and 19162 is a sinister development.

FCC DOCKET 19555 STATUS

The Commission has refused to extend the deadline for comments and answers to comments on this proposed rulemaking to limit radio towers and antennas for environmental purposes.

In the many comments filed with the FCC were some good points to ponder, should this docket ever be accepted. One comment was that the FCC is not included in the official list of federal agencies involved in environmental regulation and that congress never intended the FCC to engage in any such activity. Since radio signals have no effect whatsoever on the air, water or soil, the only possible connection with the environment is esthetic – which seems totally out of field for the FCC.

If the FCC does get involved with this, the delays in construction might well run into years and millions of dollars will be spent by the government and applicants on the hearings. This has the appearance of empire building by the FCC.

The Association of Federal Communications Consulting Engineers complained that the proposal will be an unnecessary expense upon the applicants and the FCC – and that environmental impact is always a factor of concern to the local communities and is normally handled before local zoning boards. They could not see how an additional filing (and delays) with the FCC would provide any new information over the present procedure. And if these fellows don't have the background to judge the situation – who does?

One cable company mentioned that it has already had to obtain the approval of six separate agencies to build a 150 foot tower. It is difficult to see where the added expense and delays of FCC esthetic approval will add anything but more bureaucracy.

If the FCC is able to ignore all of these comments and go ahead with 19555, then not only amateur radio is in trouble – the whole country has a problem.

CROSSBAND

The recent FCC rules prohibiting crossband looked all the more foolish the other day when I sat in on a multi-hop repeater system which extends over several states and makes it possible, in emergency, to pass messages from an amateur in one state to another well over 1000 miles away.

To me, one of the reasons for the existence of our great hobby is to

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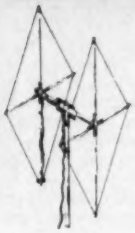

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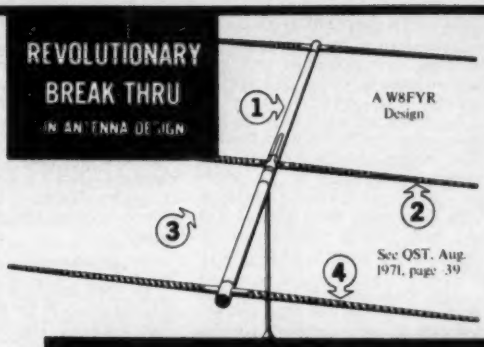

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See QST, Aug. 1971, page 39

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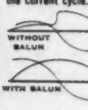

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promote this type of development and experimentation. Here are a number of clubs and individuals who have worked together to set up a working system – a very intricate one – which is fun to use and could be of tremendous value should the need develop. The control circuits involved challenged the ingenuity of the designers – the terrain covered is incredible, with the repeater paths jumping back and forth through mountains, sometimes on two meters, sometimes on 450.

The result was that I was able to break in with my 146 hand unit and talk over this entire network, covering over one thousand miles!

Sure, under normal circumstances the net is just used for local contacts and not hooked up for the long haul – but the control functions are there and it can be set up automatically from anywhere in the system if the need emerges. This is the type of amateur work that the FCC has recently legislated against.

And the excuse for making such a setup illegal? Frequency conservation!

When the time comes that we are really pressed for channels we will limit such systems ourselves – we don't need the Commission trying to crystal ball our remote future. And even if the time comes when the sparsely populated states have so much FM activity that 146 and 220 are both filled, the fact is that this will be for only a few hours a week and we will still have zillions of channels available for any kind of exotic long range relays or crossband setups we want during the off hours.

WHAT REALLY COUNTS WITH THE FCC?

Perhaps there is a lesson to be learned from the coming loss of the best part of the amateur 200 MHz band to the CBers.

Amateurs have been decent law abiding citizens – they have, with only a very few exceptions, observed the power restrictions – they have kept within their bands – they have used nice language – in all you probably couldn't find a more conscientious group.

The CBers, on the other hand, are the antithesis of the hams. They are illegal in just about every possible way – they use illegal power, almost without exception – they use illegal calls – a great many are not even licensed – they use illegal antennas and towers – they use illegal frequencies – they use illegal language – illegal hamming – about the only thing they have done to justify their existence is to spend money. Perhaps that is all it takes.

When you consider that there are an estimated 1.2 million CBers, and that virtually every one is operating illegally in a dozen ways – and then you compare this with the 250,000 amateurs, not one single man of which is using the CB tactics, and you realize that amateurs have committed one major sin – and it is such a sin that it is unforgivable: they haven't grown – so they don't spend as much money.

WHO NEEDS A LOBBY?

Do radio amateurs have to just sit still and get it in the neck (or lower) from the FCC? The flat rejection of every single petition for relief from the parts of the new regulations which were most objectionable appears to have sent a wave of depression through the ranks – and the resentment is growing.

Is there, in fact, any hope for relief?

We need to examine several aspects of the situation before we can come up with a good answer to the question. We must take a closer look at our complaints and see how serious they are. Are they worth a major effort to correct? Or are they just minor gripes that a few soreheads have built up into a big deal in order to attract attention? We need to see if the advantages of the new regulations are enough to trade off the disadvantages – did we win more than we lost?

If, after taking a close look at the whole situation, we decide that dammit, we are getting the dirty end of the stick – then we have to figure out what can practically be done about it. In order to work this one out, we must get some perspective on how the FCC works and what levers can be used to tilt things in the direction that we think best. This means that we have to have a rather good idea of how our government actually works – which, unfortunately, hardly anyone does.

There are two excellent recent paperback books which will give you some perspective on how our government really works. You'll find both of these books not only well worth while to read from the viewpoint of entertainment – and from the aspect of having a whole lot to talk about over the air – but you will get a good grasp on what is really happening down there in Washington and how the "system" works.

The first is the Ralph Nader Congress Project: *"Who Runs Congress?"* This is a $1.95 Bantam YZ7701. If this one doesn't bug your eyes in disbelief then you either can't read or you are a congressman.

Back up the Nader book with *The Washington Pay-off"* by Winter-Berger, an ex-lobbyist. This is $1.75, Dell 9509. Did Johnson pay Bobby Baker $1 million to keep his name out of his testimony? Etc. By the time you've read this book you'll have a good perspective on lobbying and how the EIA has been able to get so far with their proposal to take the best part of the amateur 220 band and give it to the belligerently illegal horde of CBers.

There are several other very good books on the subject, but these will give you the perspective you need for starters. Recommendations from readers along this line will be appreciated.

It appears that without a lobby in Washington amateur radio can look forward to a lingering death. The basic rules which permit amateur radio to grow or force it to wither away are determined in Washington and are determined to a large extent by politics. The recent response by the Commission to the massive protest to the new regulations certainly proves to any reasonable man that the Commission is totally deaf to input from amateurs. The question is: what can we do to be heard?

A Man in Washington could help. Someone with an understanding of the problems of both the amateurs and the FCC – a man who could talk with not only the amateur division of the Commission, but get through and talk directly with some of the Commissioners would be of inestimable help.

There has been some talk recently of the possible opening of new ham bands and of reopening most or all of the old 160 meter band. These things are possible if we have the clout to get them through. If we continue as we are now, they are so far off in the future that they will be of more interest to our children than us.

You know what is holding up the 160 band? Heel dragging by the Coast Guard. The old fashioned World War II Loran still buzz sawing great gobs of that band is as obsolete as the buggy whip. The newer navigation systems using satellites are so superior that the demise of Loran would be an international boon for it would force the few remaining users to update their equipment. A little pressure through a congressional committee and we could get the last of the Coast Guard Old Guard to give up this completely outdated service.

A lobbyist who could communicate with all of the amateurs of the country (say through 73) would have a lot of clout. He might not have as much money to hand over in an envelope for a campaign contribution,

but he would have a lot of votes he could deliver. Remember that though there are only 285,000 of us, this is not inconsiderable by the time you add up the effect that each of us can have on our family and neighbors. Sure, we represent about 0.1% of the population. But we also represent a wife – a father – a mother – father and mother in law – co-workers, etc. This can beef our influence to maybe 0.5% or even better. Show me the congressman who will not devote a whole lot of interest and time to a project that can bring about such a significant percentage of votes.

Just imagine what we could do if we ever got a burr under our blanket and set out to back up a senator or congressman! Or to sink one. There are 1600 amateurs in New Hampshire – and if we suppose that we get 500 of them to get out and work hard for a senator – extolling his virtues, talking down his opponent, getting bumper stickers all over the state – signs – organizing talks on local radio and television stations – he would be a shoo-in. And this would work the same everywhere.

We might have to prove this a couple of times– once might do the trick. Then, when the amateur radio lobbyist in Washington called a congressman and asked for help, he would get a willing ear. In case you don't know it, being a congressman is one of the very best jobs in the whole world and those that have accomplished it understand this and are willing to do just about anything to make sure that they keep that excellent job. They know that votes=money and that 1000 votes is about the same as a $5000 contribution, with no problem about reporting the money involved.

A lobbyist would know when and where it might get the most mileage for amateur radio if the national news media were used to advantage – like picketing the FCC offices – picketing the Commissioners – or something like that. Amateurs have the great advantage of being everywhere, so if it were decided that something along this line might be effective, it would not be difficult to organize a nationwide picketing of FCC offices, complete with engraved invitations to the television reporters to send cameras.

The fact is that amateurs could have substantial clout if they were organized. And the fact is that we are in no way organized, even remotely, for this sort of thing.

The ARRL does a fine job of publishing a ham magazine and inspirational booklets – it provides us with code practice through W1AW (and its paid operators) – it provides contests and awards – it occasionally files comments with the FCC. The ARRL does all of these things and amateur radio is the better for them. But the League does not get involved in national politics and with lobbying and the League has indicated that it has no intention whatever of ever getting into this.

Lobbying and Washington activity would be expensive to get started – and the League is presently operating at a net loss each year. It is perhaps interesting to note that a close examination of the ARRL operating statement for 1971 shows a net income of well over $1.5 million and expenses for membership benefits other than publishing of about $23,000. That comes to about 1.5% for the ARRL and 98.5% for QST. Obviously this doesn't leave much cash for setting up a lobbyist.

If anyone has any better figures on how much the ARRL spent on its members outside of publications and getting material for publication, they will be most welcome. There is no intention of laying out anything but the real facts. I realize that the mere mention of ARRL is enough to set some people on edge and convince them that the ARRL has been attacked. The above should not in any way be considered an attack – it is an attempt to bring things into focus so the situation can be understood. There is nothing whatever wrong with ARRL spending 98.5% of its money on publishing – this is the will of the board of directors and this supposedly represents their best evaluation of the way to get the most from the income of the League.

If there is no reasonable way to expect relief from the ARRL, is there any other possible solution? Frankly I don't know of any offhand, but if any readers have any ideas or suggestions I am sure that a lot of people will be interested. We need one good man in Washington – an experienced amateur – and we need the money to keep him in action – perhaps something on the order of $25,000 a year would do the job – and that would come to about 10¢ per amateur per year.

Now, to get back to the matter of whether there really is enough of a reason for such drastic action. After all, some argue, the armed forces need amateur radio and will never let it be killed off, so we don't have any serious worries. For that and quite a few other reasons I don't expect amateur radio to be shot down outright. But the indications are that it could easily fade away under the onslaught of discouraging rules. The recent proposal to limit ham antennas to almost unusable heights – the incredible repeater rules – the lack of more frequencies for phone ops in the lower bands – the years of delay on even the simplest of needed rule changes – the isolation of the FCC from the amateurs – the recent rejection of every single petition filed for repeater regulation changes – and so on . . . all would seem to indicate the need for some avenue of relief.

We need a system working for us that will result in needed regulations being passed in a reasonable time – we need to have some way to challenge regulations which are not to the benefit of amateur radio – we need to develop ways of encouraging amateur radio to grow.

Amateur radio has a great deal to give to the world – if it is permitted to do this. The hobby can help emerging countries to grow – radio amateurs in these countries can help to design, install, operate and service electronics and communications systems. Amateurs can continue and develop their ability to provide emergency communications anywhere in the world. Amateurs can develop their unique ability to permit people anywhere in the world to talk directly with other people, for not even tourists have the close fraternal ties that bind radio amateurs everywhere. Amateurs, if not prevented by bad rules, will be able to pursue their development of new systems of communications.

Imagine what would be possible in the way of worldwide amateur communications if the ARRL/IARU had managed to preserve the bands for amateur radio satellites! Imagine what might have developed in the way of multi-band repeater systems if we had had a man in Washington to help us get the regulations we really needed for repeaters! When we see what we have lost so far through not having political pressure, it is difficult to understand why anyone would be opposed to our getting such clout for the future.

The present system, which requires years and years of delay for even the simplest of changes, makes it completely impossible for the rules to be relevant. Just look at the short time it took the phenomenon of FM to spring from just a few experimenters into one of the widest spread of amateur services! Within a period of about two years we went from about 5,000 FMers to 35,000. Look at the sudden popularity of slow scan television, going from a mere handful of developers to several thousand in over 60 countries in a couple of years.

The rules should be able to keep up with these quantum jumps in interest and should be able to meet the current requirements of the

Continued on page 115 . . .

SSTV SCENE

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N
Birmingham AL 35210

Slow Scan is one aspect of ham radio that enjoys continuous experimentation and advancement. One of these "Slow Scan specials" is stero, or 3 Dimensional SSTV. Although 3-D never really made it big at the movies, (probably because a satisfactory means of projecting 3-D was never developed) the possibilities of 3-D on television were never investigated seriously.

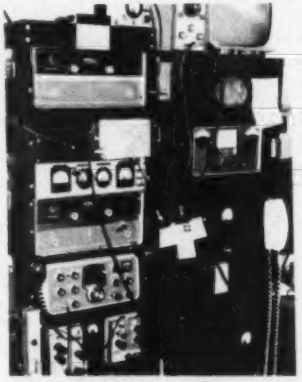
3-D Slow Scan may be accomplished by transmitting two pictures of a particular scene and shifting the camera (horizontally) approximately 4 inches (distance between your eyes) between the two pictures, to attain the proper difference in perspective. These two pictures are transmitted, and photographs are made of each "picture" when received on the monitor. The photographs are then viewed in a Viewmaster type 3-D viewer. Direct view, or real time pictures are also possible by using a split screen (two pictures) and prism viewing arrangement, to bring them into the proper perspective. Hmm – maybe a "snap-on 3-D viewer" for Slow Scan monitors would be the answer . . . At any rate, some interesting experimentation is possible here with your own gear.

Recently, Ed K6LOM visited King Hussein, JYL, and they shook up the Slow Scan troops on 20 meters as JY9LOM. I understand they operated from King Hussein's palace, and Ed didn't carry over his SSTV gear, so evidently King Hussein now has his gear working.

If you're building an electromagnetic monitor of F.S.S. and having trouble locating a C.R.T., yoke, or 931 phototube, contact Ben K5IRO. He has approximately 70 of each (5FP7's, 931's, 50 degree yokes, and focus yokes) available for his cost plus shipping. A limit of two per ham is desired, so all needy Slow Scanners will have a chance to acquire their necessary "goodies." Incidentally, watch for Ben's article in QST on a relatively simple magnetic F.S.S., complete with graphs for proper placement of C.R.T.'s, lens, and photo.

The W9NTP shack.

The pictures in this month's column are of the W9NTP, Don Miller's, setup. In addition to Slow Scan and satellite work, he is also active on RTTY and Fast Scan TV. I understand the flat country of the midwest is very good for Fast Scan DX. I've heard Don also has a 21 inch Slow Scan monitor so I suspect this still isn't all of his gear.



At the left is his rack of OSCAR 6 gear.

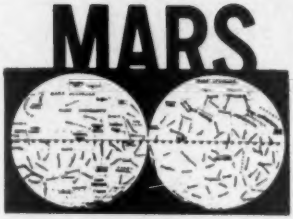
A mini Slow Scan convention is being planned for the '73 ARRL New England Convention at Dufney's Hyannis on Cape Cod, Massachusetts, during September 29 and 30. Their past conventions have drawn a crowd second only to the Dayton blast, and their 1970 convention boasted the first Robot public unveiling. Gene W1VRK, is heading up the Slow Scan activity, so you might contact him for more info.

There are quite a few more Slow Scanners (and cameras) appearing on the air lately, which brings to mind a camera operating precaution I feel needs reemphasis. Beam current should be kept as low as possible, and target gain high enough for good quality pictures. Although good pictures are also obtained with high beam current, this will quickly "burn" into the vidicon or plumbicon target. Unfortunately, some operating manuals take this too lightly.

DX season is here again, and we're looking for pictures to run in the column. If you need them back, that can be arranged also. Any takers?

73, Dave K4TWJ

MARS



Harry Simpson A4SCF
c/o 73 Magazine
Peterborough NH 03458

A subject not previously covered in these efforts was brought to my attention by a very nice letter from a young man, Steve Antosh WB5BNM, who lives in Shawnee OK. Steve says, " . . . I am going to enlist in the near future, and I would like some advice on which service has the best all-around electronic training. I want to become a MARS member, but I feel that I should join the MARS program of the service I eventually choose!"

Young Steve is knowledgeable far beyond his sixteen years! Others would be wise to follow his example – to check into the specific training offered by each service, then make his or her choice. I feel sincerely that *all* the MARS programs are good; although administrative procedure differs, training and discipline are similar; I feel that a young Army MARS member would make a better Marine, that an Air Force MARS member would make a better sailor, and that a Navy MARS member would make a better soldier than the same individuals without such training as that offered by our MARS programs!

Several years ago I received a letter from a young man then stationed in an Army installation in Germany. He said, in part, "I just wanted to take a moment to thank you for the Army MARS training which I received as a member of your Net. As a direct result of that training, I was able to assume operation of this elaborate Control Station with a minimum of confusion."

This young man continued the operation in Germany until his transfer to Vietnam and still another communications facility. He would have had a successful career without MARS, but he feels even today that he was able to end up with the radio equipment that he loves, much more easily as a direct result of his prior MARS training – as a civilian, by the way, he is *still* an active MARS member, and a Past District Director in the Third Army program! Army MARS offers its members a Pre-Induction Certificate, to be presented to the final interviewer at the Induction Sta-

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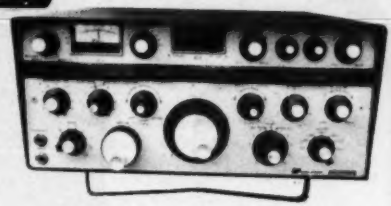

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30 WATTS OUTPUT. ALL SOLID STATE (no tubes). TRUE FM (not Phase modulation) for superb audio quality. 10 channels with 146.94/146.94 included. Three pole low pass filter on both transmit and receive. 1 watt low power position. Provision for tone encoder. Simple internal strapping provision allows multi-channel use of any crystal. Microphone and mobile mounting bracket supplied. Professional level construction by distinguished Avionics Mfg. – General Aviation Electronics, Inc. The finest amateur FM transceiver available at any price. Size: 9 x 6 1/2 x 2 1/2. Weight 5 lbs. Current Drain: Receive: .09 amps, Transmit: High 5.0 amps, Low: 1.7 amps.

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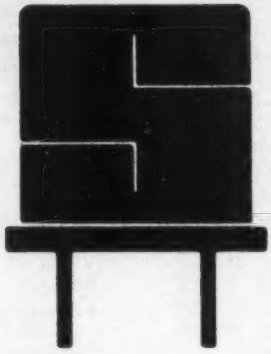
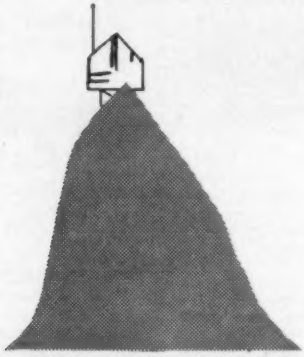


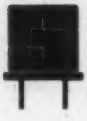
REPEATER OWNERS

Don't Take Chances. SENTRY offers custom made crystals made exactly to your specifications. When it comes to crystals for your repeater, BUY THE BEST – SENTRY.



REPEATER USERS

If you want reliable access to the repeaters in your area, you want and need SENTRY CRYSTALS. SENTRY CRYSTALS are custom made for your rig. We don't stock a large quantity of crystals for a certain frequency and hope you can tweak them to frequency in your rig. We do offer FAST service on crystals made especially for you and your rig. If you want reliable, on-frequency operation, INSIST ON SENTRY.



SENTRY MANUFACTURING COMPANY
Crystal Park, Chickasha, Oklahoma 73018

PHONE: (405) 224-6780
TWX-910-830-6425

tion, as an aid to getting the proper training and assignment. The other MARS services offer a similar Certificate.

Big News! I have some volunteer assistants! For information about joining the MARS program of your choice you can now write directly to these three persons who have so graciously consented to assist me: Air Force MARS, *Mr. Andrew C. Mueller AFB9BPG, 2222 Oaklawn, Waukesha, WI 53186.* Army MARS: *Doris Dennstaedt AD3HEN, 303 N Hammonds Ferry Rd, Linthicum Hts MD 21090.* Navy-Marine Corps MARS: *Mr. Richard Crowell N@ASC1, 803 Oak Plaza Rd, Kingston TN 37763.*

(Actually, Mr. Crowell didn't volunteer – I volunteered him. After I threatened to disclose his West Tennessee background he reluctantly agreed to disclose information on how to get into Navy MARS to those who are interested.)

Now that I have delegated all this authority, with the assurance that information will be forwarded to those who request it, you ask what is left for me to say – that's simple – 73.

A4SCF

CA	WA6LNU	Los Angeles (AM)	222.20–223.80
CA	WA6TDD	Los Angeles (FM)	147.435–146.40
		(AM)	147.405–
CO	WA0VTV	Colorado Springs	37–97
CT	WA1KGK	Bridgeport	147.48–146.69
GA	WB4QGF	Atlanta	444.50–449.50
IL	W9MJL	Danville	22–82
IN	K9SJI	Muncie	13–73
MD	WA3SFG	Greenbelt	28–88
MA	W1DC	Billerica	147.72–12
MA	WA1QFD	Marlboro	01–61
MA	K1UHU	Walpole	31–91
MA	WA1OXW	Fall River	146.43–147.42
TX		Mt. Franklin	28–88
VT		Mt. Snow	07–67
WI	WB9JPN	Lake Geneva	37–97
ONT	VE3GOD	Goderich	146.43–147.03
			146.46–147.06

Keep those Cards and Letters Coming!

Your new repeater, or your present machine with its new frequencies, is destined to remain practically unknown to the rest of the world unless you get the information to the Repeater Update . . . pronto!

All published updates are automatically compiled by our computer-like staff and added to the listings in the Repeater Atlas. While you can always (horrors) chop-up every issue and compile the new listings as they are published, an easier way is to send us a buck and a half for a copy of the brand-new-still-wet 1973 Repeater Atlas. It contains a listing for every repeater known, including maps, open or closed status and tone frequencies. Update!

ARRL RESOLUTION

One of the more important developments in the FCC vs amateur radio battles was the following resolution by the ARRL Board of Directors in January. This is a strong statement and it puts a heavy load on the shoulders of the president and general manager of the League for it says that in effect the Board is holding them responsible for results.

WHEREAS, the highly developed radio communications technology existing in the world today is the direct outgrowth of contributions made by radio amateur enthusiasts over a period of more than 70 years; and

WHEREAS, the government of the United States including various administrative agencies, has traditionally followed the policy of permitting and encouraging the development and growth of the amateur radio service by adoption of only minimal regulations and broad general policies; and

WHEREAS, under the policy of minimal regulation the amateur radio service has developed to an extremely high level of proficiency and service to the nation in times of disaster and national emergency as well as in normal periods; and

WHEREAS, the Federal Communications Commission in recent months has adopted a number of amendments to its regulations and issued a number of interpretations of these and other regulations which evidence an abandonment of the policy of minimal and self- regulation followed so successfully over the years, and has other proposed restrictive amendments under consideration which, if adopted, will further increase the level of governmental regulations; and

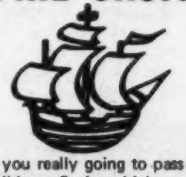
WHEREAS, these developments and trends are a matter of the greatest concern to amateurs throughout the nation and to the American Radio Relay League, the only nationwide membership organization representing active amateur radio licensees of all ages and interests; and

WHEREAS, a great number of amateurs, individually as well as through their local clubs affiliated with the League, have expressed deep concern over the apparent trend toward progressively restrictive and unilaterally-imposed regulations governing the Amateur Radio Service, and the potential inhibiting effect of this upon the orderly development of the Service as a public resource, as well as in carrying out the charter in Section 97.1 of the rules,

Now, therefore, BE IT RESOLVED, that the President and the General Manager are directed to undertake a vigorous program to seek reasonable and technically viable philosophies of regulation and interpretation, conferring at all necessary levels with appropriate Government departments and officials, and recommending to the Board of Directors courses of action which may be required to assure the continued availability of traditional latitudes and freedoms, and the full public service capabilities essential to the growth, improvement and usefulness of the

Adopted Unanimously
January 18, 1973,
by the Board of Directors of the
American Radio Relay League.

APRIL CRUISE



Are you really going to pass up the 73 Caribbean Cruise which runs from April 3rd until the 13th? Come on – join us all for a lot of fun – for ham talk – visiting very rare islands you otherwise would never see – for some DXing – for plenty of sun – swimming – skin diving, if that turns you on – and sailing.

The price runs about $290 per person for the ten day trip – which is a darned good bargain these days. If you think you're interested get in touch with Captain Mike, Windjammer Cruises, Box 120, Miami Beach FL 33139 – telephone: 305-672-2213.

As of the first of the year there were about a dozen signed up for the trip – including some of the better known amateurs. It'll be fun. It starts from Antigua and ends up there again after ten glorious days.

73's WORLDWIDE SALES REPRESENTATIVES

U.S. AREA REPRESENTATIVES

New Mexico/West Texas
Ambrose G. Barry, W4GHV/5
1010 Juniper Avenue
Alamogordo, New Mexico 88310

DX REPRESENTATIVES

BCN Agencies Pty. Ltd.
178 Collins Street
Melbourne 3000, Victoria
Australia

The Wireless Institute of Australia
478 Victoria Parade
P.O. Box 36
East Melbourne, Victoria
Australia

Carlos Rohden
Caixa Postal 5004
Sao Paulo, S.P.
Brasil

Jim Coote
56, Dinsdale Avenue
Kings Estate
Wallsend
Northumberland, England

Radio Society of Great Britain
35 Doughty Street
London WC1N 2AE, England

Short Wave Magazine
55 Victoria Street
London, SW1, England

Bryan R. Vogerty
Irish Radio Transmitters Society
9 Wellington
Dun Laoine, Ireland

Orion Books
13-19 Akasaka 2-chome
Minato-ku
Tokyo 107, Japan

Gordon and Gotch Ltd.
P.O. Box 584
Auckland, New Zealand

G. H. Gillman
Smarts Road
Waikuku RMD
Rangiora, North Canterbury
New Zealand

New Zealand Assn. of Radio Transmitters
P.O. Box 1459
104 Hereford Street
Christchurch, New Zealand

Harold C. Leon
P.O. Box 61141
Marshalltown, Transvaal
South Africa

South African Radio Publications
P.O. Box 2232
Johannesburg, South Africa

South African Radio League
P.O. Box 3911
Cape Town, South Africa

Eskil Persson, SM5CJP
Frotunagrand 1
194 00 Upplands Vasby
Sweden

Francisco José Martin, YV5EBD
Apto. 64 Prados del Este
Caracas 108, Venezuela

Those of you who have not sent in your score for our 73 - 73 - 73 Award (73 countries, first 73 days of 1973). Had better check over your log and get your list (verified by some club official or 2 hams) so that we can send you your certificate.

We still need quite a few more DX Clubs to act as WTW verification points. This is a good way for your club to get a little publicity because we will be mentioning their name and address a few times each year. The work load will not be too much, just the checking of the WTW applicants in your district. Discuss this at the next club meeting.

I hope by now all those planned winter DXpeditions have come to pass as they were planned. Many things can and does happen to make things not ever turn out as you would like for them to and this seems to happen more to DXpedition plans than anything else, all which goes to show that "something" happened that you didn't think of and I bet "money" is one of those "stoppers" ! In my case it has usually been Nr. 1. So fellows if you are thinking of a DXpedition, get your money problems attended to first. Of course there are "other things" to remember. Get used to eating odd food, not the best of accomodations, maybe no running hot water (not unless you call a native running with hot water to your room, "running". Get used to having to defend the U.S.A. (especially true I guess now). I would also guess the U.S. Dollar is not as "shiney" as it used to be either. Get ready to do battle with Customs in some countries (some will be easy if you "hold your mouth right"). Get used to having to do a lot of "talking" to taxi drivers, many of them will "drain you dry" ! The same usually goes with anyone giving you any kind of service (maids, doormen, butlers etc.) You will not have air conditioning, good heat etc. You will have to do as the old saying, when in Rome, do as the Romans do, something you may not like to do. Then when you get on the air to work the fellows, there will be a lot of deliberate QRM on your (and the other fellows) frequency, some will call you every day just to say hello, call letter districts will most definitely call out of order, you will be accused of working too much CW or SSB, favoring certain districts or calls. Then when its all over you will get cards from fellows who will swear with witnesses that they have worked you at such and such a time, band, etc. And they will not be in your log ! NOW, DO YOU STILL WANT TO GO ON THAT DXPEDITION ? Well I DO ! And I bet you will still GO ! I want to warn you, be careful, it will get in your blood and you will not ever want to quit, it got in mine ! Now don't say I didn't warn you of just a few of the "hazards" of being on the other end in a big DXpedition pile-up. It's great and sometimes its rough going.

I wonder when someone will again be on from such rare ones as Iraq, South Sandwich, Clipperton Island, Bouvet Island, Spratley Island again, the many different reefs (some they say are under water), AND ROCKALL ? All I can say is WORK THEM WHEN YOU GET A CHANCE because it may be a long time before you get another chance. Most of them are difficult if not down-right almost impossible to put on the air.

I hope by now that most of you have worked the countries you need on ten meters (unless you still need such places like Brazil, Argentina, Canal Zone, and other countries south of your location, because when ten is closed by those thinned out sun spots thats all you are going to hear or work. The ten meter band this winter had all the "ear-marks" of being on its last leg, and in a few more winters you will still have fifteen to work, and then it will be the next one to "go" ! Better make hay while the sun shines on the fifteen meter band.

Any of you who have future DXpedition info (at least three months advance notice) please send me the info for publication if you want the fellows to be waiting for you and when its all over send me the story and a few good pictures, we will do the rest and hope it will give you a little more "glory" ! We can always use little DX stories, info, pictures etc. Keep us in mind please.

A group of fellow DXers headed by VE6BAA and VE6TP have announced some "big" DXpedition plans (in late November) and we all hope by now that they are well on the road. They have announced plans to put on the air the first ten or so most needed countries. I can see a lot of money being spent on this trip or trips when you consider they plan to make a series of movies (they will have a movie making crew along with them in addition to the ham crew (I guess some 3 to 5 hams). Someone must certainly have a "bank-roll" to see all their announced plans materialize. Of course they will accept any donations sent them (and they will need PLENTY) not unless there is a very rich "sugar-daddy" in their crowd. The frequencies for working them is as follows:

SSB-3770 - 7080 - 14190 - 21245 -and 28550 kHz.
CW-3505 - 7004 - 14025 - 21025 -and 28025 kHz.

All QSL cards to them should go to:
VE6BAA, R. "Bob" Sutherland
c/o Canadian World DX-pedition
Edmonton, Alberta - Canada

Donations with your cards will be FB. Their first stop that was planned for late December was put off until Jan. 1973 and we hope it is "past-history" by now and that they are at some of those other "goodies" announced by now.

As I predicted a long time ago VS9 (Aden) is a rare spot since the "G" fellows pulled out and by now EA9 (Spanish Sahara) has probably joined the rare country list because EA9EJ Justo was to have left there for EA8 (Canary Islands) in late December and DXpedition planners will find it very difficult to get a license and permit to operate from that spot. I spent 2 fruitless weeks in Madrid trying and I never even found the "right man" to talk to ! Oh, I was sent all over the place (the usual "run around"), and I went everywhere they sent me, none of which did any good what so ever.

Fellows, remember when you are chasing some of that DX and the other fellow on the other end is not an Eager Beaver DXer, and that working one more "W/K" is Duck Soup tc him that he is the one thats doing you a favor by working you. So I very strongly suggest you play the game by His Rules (by districts, lists etc.) You may not like his rules, but he is his own referee and he does things like he wants to. He is the fox and you are the hunter.

Tim Fitzpatrick ET3USB and WB8BOI. Tnx to WB8BOI for photo.

To be a GOOD DX'ER takes work, planning, a good rig and antenna, and of course a certain amount of time. But, you will never enjoy it all more than when you are "in there" working them in the pile-ups !

Each night just before you doze off to dreamland be sure to REMEMBER: 1973 is 73's year, repeat that each night - Lets keep Wayne Happy !

73 etc. de, Bill BPD

AMSAT NEWS

Mike Frye WB8LBP
640 Dauville Dr.
Dayton OH 45429

Now that OSCAR 6 is a success, AMSAT is busily involved in the construction of AMSAT-OSCAR-8. AMSAT hopes to launch the satellite soon after OSCAR 6 ceases to operate. AMSAT needs volunteers to assist in the development of satellite hardware. Administrative and financial help is also needed for this project to be successful.

I am really sorry to learn that some stations are using excessive power in transmitting to the OSCAR 6 satellite. This of course is clearly a violation of Section 97.67(b) which limits amateur radio stations to "... the minimum amount of power necessary to carry out the desired communications." It also violates the rights of fellow amateurs. I have talked with quite a few friends who have tried to make a contact only to have interference from a high powered station blot them out.

I am happy to announce that many amateurs sent comments to AMSAT with suggestions for future projects. One proposal that has been considered came from Joe Kasser G3ZCZ/W3 – he has suggested the idea of having a repeater attached to an atmospheric balloon. The program would investigate the use of non-space qualified hardware to enable tests to be made on hardware that will be utilized in future space flights. If you have any ideas on this subject, please send them in. Also, if you have any experience in balloon work and would like to help, write to Joe Kasser at the address listed in his "Travelling Ham" column.

Other ideas involve a synchronous orbit for OSCAR 7 – this would allow the satellite to be at optimum position most of the day. It would also allow for the numerous contests and DX possibilities that would be welcomed by all. Many other atmospheric and propagation tests were suggested for OSCAR 6, and I have heard that a group of amateurs are already getting fair returns on their experiments.

Please continue to send in your suggestions to AMSAT, as we are still looking for new ideas.

The next column will include – hopefully – some of the data observed from the tests with the satellite. Be sure to monitor the three AMSAT nets to learn how to listen for OSCAR if you are still having trouble.

AMSAT NETS
3855 kHz every Monday at 2400Z (7:00 p.m. EST)
14,280 kHz every Sunday at 1800Z
21,280 kHz every Sunday at 1900Z
WB8LBP

The Hamburglar
STRIKES AGAIN!

Roy Barker WA8PCG had a Standard 826M 2m FM rig, serial no. 112007, stolen from his automobile recently. If anyone has information of the whereabouts of the rig or of the theft itself, please contact Roy at 23185 Maybelle Dr., Westlake OH 44145 or the Cleveland Police Department.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72
HR-2A, 11 chan., 04-07152	WA1NVC	9/72
Swan Cygnet 270,No. 313022	K4ACJ	9/72
Collins Mic, Mod. MMs, No. 4294	K4ACJ	9/72
Heath HW-100 & AC P5	WA2JGP	10/72
Swan 270B, No. M-395430	W8HST	11/72
AF68 No. 10888 PMR8 No. 10918 M1070 pwr supply	K5LKL	1/73
Trio TR2200 No. 241969	WA2ZBV	1/73
Clegg 22er No. 1900-578	W1DHP	2/73

WHOOOPS

The notice making kits available for the Handy-Talkie Touch Tone article on page 32 of the January 73 issue was worded incorrectly. W1WJR is NOT offering complete kits ... he is offering just the pad and switch for the listed price. The mistake was *our* fault ... we simply misunderstood Tom during a telephone conversation.

50 MHz BAND

Bill Turner WAØABI
Five Chestnut Court
St. Peters MO 63376

KØTVD reports the band open from Nebraska nearly every day during December, with the 9th and 17th being exceptionally good to the east coast. Santa brought Chuck a new 11 element Telrex. He hopes to have its 36 foot boom at the 70 foot level by early spring.

WA1EXN, Maine, reports E and/or scatter contacts during 13 of the last 22 days of December. Among those heard and/or worked were WB4LHD, WA5YJR, WA5MZW, K9HMB, WA4MHS and WA5SJM. Art is toying with a 25 mW CW rig on 50.178. "So far have made only local contacts but will be looking for DX next summer. (I think I must have been dropped on my head when I was small.)"

The local area shared the fine December openings mentioned by Chuck and Art. Among those heard here were VE1PL, W2EIF, K3CFY, WB4BND, WA1JEX, WA1NNW, WB9ETQ and KØMST. The first few days of January were not bad, either – WA7FPO and WA7BXK were heard around 0100Z on the 2nd. Charlie, WA1PFA, was worked at 0330 on the 6th after he finished chewing the rag with K8LEE. Wayne could be heard but not copied off the back of his beam.

The January ARRL contest was a complete and absolute bust in this area. Few stations attempted to participate – even the normally good groundwave to 300 or so miles was poor.

While on the subject of contests, don't forget the "Worldwide VHF Activity" sponsored by the Itchycoo Park VHF Amateur Radio Society. It runs from 3:00 pm local March 10th through 10:00 pm local March 11th. Full details are to be found in "Social Events and Contests" in the January issue.

Several weeks ago I noticed an ad for a new 6 meter transceiver and wrote the manufacturer for further data. This information has not been received as yet, so I will pass along what I know about it. The manufacturer is SBE, the rig is solid state, 20 watts PEP SSB and 10 watts AM. Frequency selection is by 23 synthe-

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☐ Standard 826	☐	146.22–82	☐
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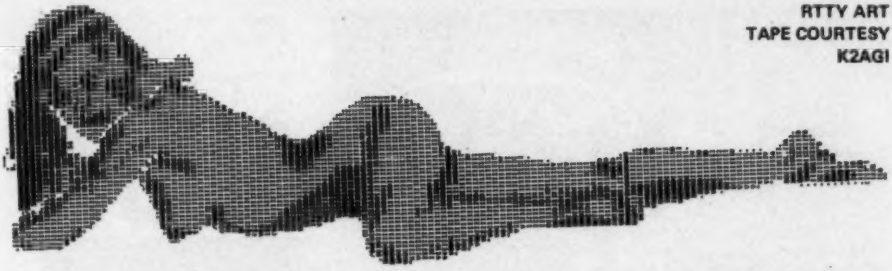


RTTY ART
TAPE COURTESY
K2AGI

sized 10 kHz channels (incremental tuning?) which makes it sound much like a conversion of a CB rig. The coverage is from 50.050 to 50.280 which would seem to be reasonable. Hopefully the PR department at SBE will be able to fill in a few of the voids before the next column deadline. How about a new rig before the next E season?

A little more information on the Tempo 6N2 linear I mentioned last month. This is a table top unit with self-contained power supply using a pair of Eimac 8875's. The input is 2 KW on SSB and 1 KW on CW and FM, 50 to 75 watts of drive are required. Deliveries were scheduled to begin in January at $545.

You might want to look for the "Ohio Valley Coffee Club" at 8:00 a.m. EST Sunday on 50.150. Another net to look for is the "East Coast SSB Net" at 11:00 a.m. EST on 50.175. W3MFY passed the word on this one from the Philadelphia area.

I have an inquiry about the solid state 6 meter transverter kit available through the English language version of UKW-BERICHTE. I have not personally seen or heard one. Can anyone supply a first hand opinion?

WAØABI

Bill Pasternak WA2HVK/6
14732 Blythe Street #17
Panorama City CA

It was in 1962 that I last tried my hand at writing. I must admit that I am more than a slight bit rusty at it. Why then am I crazy enough to undertake what I hope will become a monthly column about FM activity in the Southland? Perhaps the answer would be simpler to explain if you permit me to digress for a moment.

I believe it was in April of 1970 that the incident took place. I was here in Los Angeles on business and had a borrowed P33 with me. The only rocks in the thing were for 94 simplex. I had been quite busy that day trying to peddle light shows, and to relax I decided to see what I could work from my hotel room. I gave a short call, figuring that my WA2 call might attract some attention and lead to an interesting QSO. It attracted attention all right, but hardly the kind I was expecting. As soon as I let go of the PTT button, I was greeted by a fellow amateur (I use that term quite loosely) who never bothered to identify himself. Instead he spent the next three or four minutes explaining to me that I was not welcome on 94 and that I had better get off the air or else. Needless to say I was startled by this. When I asked why, I was answered with a tirade of four letter words that would make a sailor blush. Since I was leaving for Albuquerque the next morning, I turned off the P33, packed it away, and went to visit some friends instead. (They are of the non-ham type, so the evening was spent talking of film making rather than ham radio.)

It was not until I returned to New York that I learned this was not an isolated incident. Others, I was told, had been greeted with the same "warm welcome" of true amateur friendship. Though I wondered why, with time the incident was forgotten. It was six months later, when I again came to L.A., that I learned the answer. This time I carried with me a Knight TR-108 two meter AM rig. It was during one of the many fine AM QSO's I had during that stay that I learned about FM in Southern California and about Remote Base operation in particular. It seems that I had been on someone's remote base frequency and apparently he didn't appreciate my intrusion. What bugged me then, and still does now, is why this guy didn't take the time he spent threatening me to explain about his operation. I would have been happy to comply with his request not to use the channel. No, instead he made himself look quite small in my eyes and helped to give this area some undeserved bad publicity about two meter FM and the people on it.

Back East, most of the people I have encountered believed as I did that FM in Southern California is very unfriendly, and the people involved in it are of the very up-tight variety. This, as I have come to find out, is far from the truth. It was Fred Deeg K6AEH of Standard who opened my eyes to the true facts of FM life here in L.A. I first encountered Fred on WA2SUR when he was in New York last spring. We had quite a QSO that evening and Fred invited me to visit him if I ever got to L.A. again. Eight weeks later, I called Fred to tell him that I was here hunting employment and would like to take him up on his invitation. I visited Standard the following afternoon and after a tour of their facility, learned about repeater operation in this area. Fred is probably the best public relations man for FM in Southern California today. Why not – after all, he works for a company that is in good part responsible for the rapid growth of amateur AM all over the nation. He is also one of the founders of WB6ZDI, the Pallisades A.R.C. repeater, which is fast becoming to Los Angeles what WA2SUR is to New York. It was because of Fred and others I met, like Bob Greenberg WB6INR, that I totally changed my mind about two meter FM in Los Angeles. It was Bob who was the inspiration for this column, but more about that later.

I next spoke to Fred in mid-October, when we arrived. By that time, the Southern California Repeater Council had held its coordination meetings and the changes were going into effect that week end. Fred supplied me with a list of the new allocations, and a call to International brought the necessary crystal combinations. This got me on the air, and

Cont. on page 18 ...

report from MANAGUA

A destroyed city is not the greatest place to spend Christmas, but Managua has brought to us a holiday we will never forget. When planning our one-year journey through Central and South America, we had no idea it would prove to be filled with such adventure.

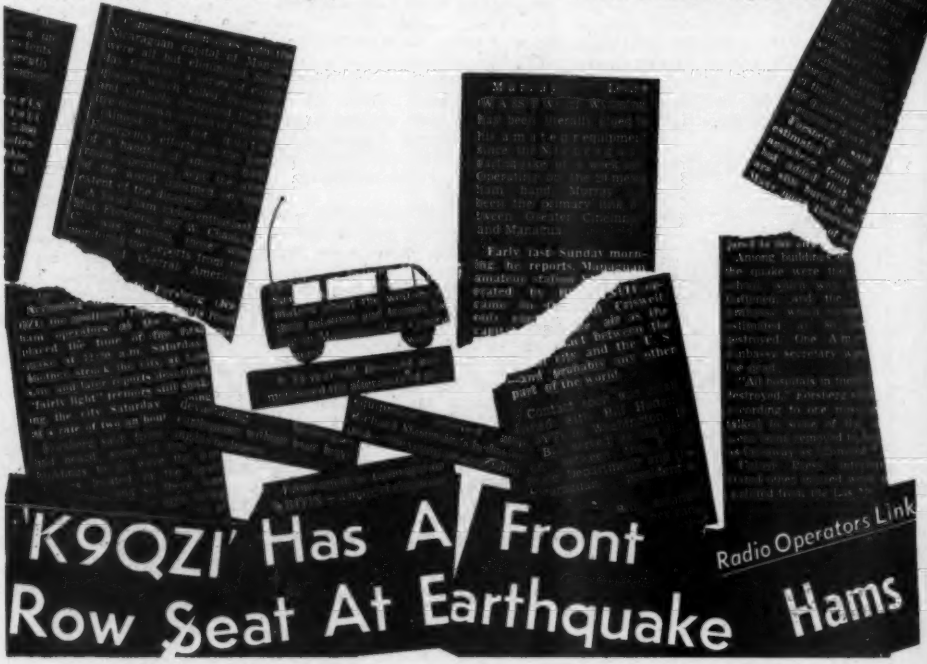
We first heard news of the earthquake Saturday evening, December 23, while camping at Lake Ilopango in El Salvador. Information was difficult to obtain; communication was obviously a problem. Nine months of effort gathering amateur radio licenses from all nations of Central and South America culminated into one moment of great opportunity. We had something to offer the people of Managua – a fully mobile amateur radio station capable of sending messages throughout the world. Words were not necessary; the decision to go had been made. It took a night and a day to gather extra food and water and to drive to the disaster area.

Those missing buildings tell the real story of the extent of the disaster. Photograph by Don Goode.

On Christmas morning we entered the city. The scene was not a pretty one. Families sat on couches or chairs in front of their crumbled homes waiting for cars or trucks to help them remove the few possessions they were able to salvage. To prevent disease spreading throughout the city, bodies were burned in the streets as rescue operations continued to uncover the victims trapped in the debris. The people of Managua maintained a surprising calm in the midst of all this tragedy.

For five days, our white Volkswagon bus with the mobile radio unit was used throughout the city to send and receive messages. "The family is alive and well" were the happiest and most familiar words transmitted.

Hurriedly dispatched to Managua, the 21st Evacuation Hospital of the



'K9QZI' Has A Front Row Seat At Earthquake Hams

Radio Operators Link

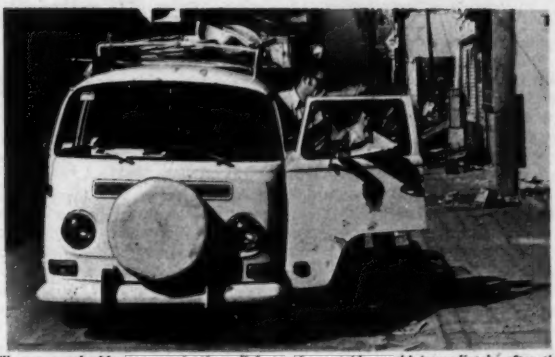
United States Army from Fort Hood, Texas, arrived *without communications equipment.* The YN1LEY mobile unit quickly established contact with Fort Hood and extra doctors, nurses, and medication were dispatched immediately.

Telephone lines were down, electricity was off, and gasoline was difficult to find. United States newsmen covering the disaster had great difficulty getting reports back to the home offices. Our Swan 500C worked day and night getting the news to the American people. Great band conditions and cooperation from ham operators in keeping the frequency clear, enabled us to file broadcast quality news reports to WBT in Charlotte, North Carolina, Voice of America in Washington, D.C., and the Texas State Network in Dallas.

Transportation was a critical problem in the city. Vehicles not crushed by falling debris were used exclusively to move people from the city. Our bus moved through the streets of Managua carrying photographers, newsmen, doctors, and embassy officials.

Shooting was prevalent during the nights as the Nicaraguan LaGuardia attempted to stop the looting. We suffered some tense moments one evening as bullets ricocheted overhead.

Incoming messages requesting information on the welfare of particular families were difficult, if not impossible, to handle. Most homes had been destroyed and people evacuated. However, some messages did get delivered.



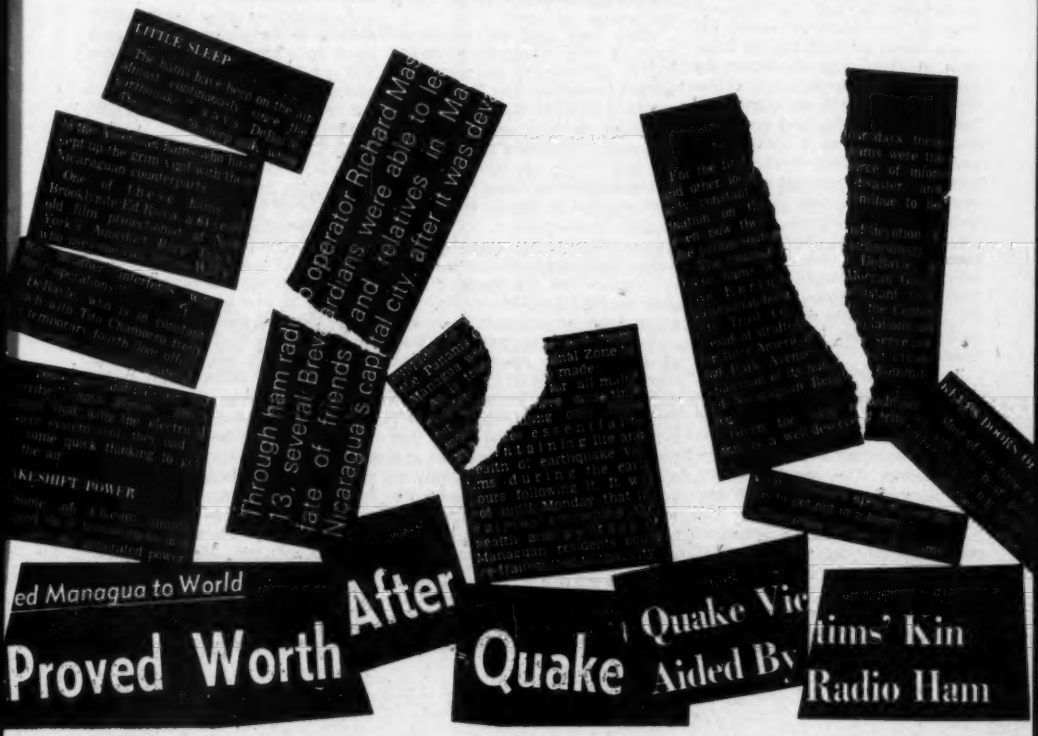
Bill was a valuable communications link to the outside world immediately after the earthquake. Lucky for the U.S. Army, he was on hand to contact Fort Hood and remind them they forgot to send radio equipment along with their personnel. Photograph by Don Goode.

One message in particular from the Vatican to the Archbishops in Nicaragua held an unusual experience for us. General Somosa, military leader of Nicaragua, accepted the message personally and assured us it would be delivered. It was quite an honor to shake his band.

One our fifth day in Managua, a badly overworked relay in the Swan 500C died. One last transmission was attempted and a replacement unit was ordered from Swan Electronics in Oceanside, California. The part was expedited immediately from the factory and, much to our delight, the radio is back in operation.

The tremendous assistance and cooperation of amateur radio operators throughout the Western Hemisphere made our efforts in Managua truly successful. We are proud to be a part of the amateur radio brotherhood.

Bill and Mareta Pomeroy
YN1LEY / WA2LEY



I've come to make many new friends.

This, though, set me to wondering why no one had taken the time to write on an on-going basis about FM out here, considering the fact that Southern California is the place that gave amateur FM its start. No, I'm not the first. The credit for the pioneering effort must go to Bob Greenberg. It was Bob's excellent letters that were printed in the Repeater Bulletin that first made those living elsewhere aware of current trends in and around this area. Perhaps it was the national publicity garnered from Bob's journalistic effort that was at least in part responsible for the quick action in standardizing the repeater channels. It was directly from Bob's effort that Looking West has been born.

Here, then, is the reason for Looking West. Though FM is big all over the country, most of what we read or hear is about the Northeast and New York. Little information is available on what's going on elsewhere. If I had known in 1970 what I know now, the incident I described at the beginning of this column would probably never have happened. How is someone from one coast supposed to know what's happening three thousand miles away. The purpose then of Looking West is to bridge those miles. I hope that it becomes a place for amateurs who are devoted to FM on both coasts – and in between as well – to exchange ideas that will benefit all. To this end I will need your help. Let me know what interests you, and we will do our best to provide information. This goes for all facets of FM, be it technical, philosophical or what have you. However, this won't be a place to air anyone's dirty linen. If you have a personal gripe about someone you might just as well save yourself the trouble of contacting me. I can assure you it will never get into print. On the positive side, if there is a matter affecting you that might affect us all, then that's news. When I say "you," I am talking to clubs and repeater organizations as well as the individual FMer.

Do we need a national repeater organization? Most repeater owners already belong to one or another regional repeater council. Some of them are excellent, but they all have one drawback. They represent only a small number of people each, in relation to our total FM population.

Many of us feel that we have been treated unfairly by the new FCC regulations governing repeater operation. Though many petitions have already been filed to stay or alter the new rules, it is yet for a concerted effort on a nationwide scale to develop. If the FCC received 10,000 petitions, all properly filed, they would be forced to at least re-think their decisions. A national repeater organization of owners and users could organize an effort such as this. Just a thought. What is your opinion?

The future of 220 MHz. As we all know, the motto around 73 has been "220 – Use it or Lose it!" Well, the fact still stands that if we amateurs don't start using 220, we *will* lose it – and to the same crowd that took eleven meters from us. The best reason to fight to keep 220 can be found by SWLing the 27 MHz Citizens Band some evening. No, I am not against CB, only the way that it has come to be used. If the FCC had been strict in enforcing its own rules governing CB, we wouldn't have the fiasco we have today. Why complicate the mess even further by adding 220 MHz to it?

A number of years ago the Gonset Corporation made a pioneering effort to populate 220 with their Communicator IV-220. (See November 1962 73 magazine for an excellent review of this rig, if you can locate a copy. Mine is not for sale.) Though their radio was state of the art for its day, very few of us were willing to shell out almost $400 to try a band that held little in activity. Between now and then there has been little or no equipment manufactured for the 220 MHz amateur band. Now, however, that is all changing.

Henry Radio beat everyone by announcing their compatible FM-AM 220TR, and followed that with their twelve channel ten watt Tempo 220. Already, most of the other major manufacturers have announced 220 MHz radios to become available later this year. There are rumors around here that Henry will soon have a 220 MHz repeater on the air. Nice work, Ted.

One thing that has been puzzling me for some time is why a progressive kit supplier like the Heathkit company has not joined the amateur FM trend. There are still some of us who prefer to "roll our own," at least partially, and I for one can see a good market for 144 MHz, 220 MHz and 450 MHz FM transceiver kits and monitor receiver kits. After all, wasn't it the venerable Sixer and Twoer that opened VHF to the average ham at a price he could afford? How many of you started your VHF career with one of those Benton Harbor Lunchboxes? It was an old Heath CB-1 converted to six meters that was my first mobile rig, and it's still in use as a base for local ragchews. Come on, Heath – how about an FM 1¼'er?

While on the sobering subject of 220, I am happy to report there is now a 220 MHz repeater operational

With members of the aforementioned Alhambra Radio Club (K6AC) handling Santa's end, it was up to Orlo K6SUJ and Eric WB6EST to do the leg work at the hospitals. This they handled with great talent. Because of their efforts there were quite a few happier hospitalized kids in the Los Angeles area. When we speak of amateur radio as a public service, we usually think in terms of emergency communication in time of disaster. I ask you, though, what greater public service can we hams give than to make a child smile?

Traveler's Note. To those amateurs who plan to use two meter FM while in the Los Angeles area, I personally recommend WB6ZDI (146.01–146.61) and WA6TDD (147.435–146.40). The people on these machines are very friendly and have gone out of their way to make your reporter welcome. ZDI has one in greater Los Angeles. It is the work of Lynn WA6LNU, and the machine bears his call. At the moment the machine is AM, but word has it that Lynn plans to convert to FM sometime in the future. AM or FM – at least it's a step in the right direction. I'm still in the process of brewing up a 220 transceiver (see, Heath, I told you so) and as of now I have not heard the machine myself. From what I have been told, though, it already has a bunch of active users.

A number of other machines are already in the works, and all signs point to a concerted effort to save 220 out here. History at times has a nasty way of repeating itself, so let's not help it do so this time. USE 220 AND KEEP THE CALL SIGNS HEARD THERE AMATEUR CALLS!

Christmas on WA6TDD. As a small child, one of the greatest joys of the holiday season was to visit one of the local department stores to see Santa Claus. Wasn't it thrilling to sit on his knee and tell him that you had been a good boy all year and were worthy of his good graces come Christmas Eve? Again this year thousands of kids all over the country had their chance to tell the kindly, bearded man in the bright red suit what they wanted to find under the tree.

But some children were not quite that lucky. I'm talking of those who were confined to hospital beds. How could they tell Santa what to bring? Thanks to the people who operate WA6TDD (147.435–146.40) and members of the Alhambra Radio Club, many of these kids were able to talk directly to Santa via the "Annual WA6TDD Phone Patch to Santa."

Continued on page 107....

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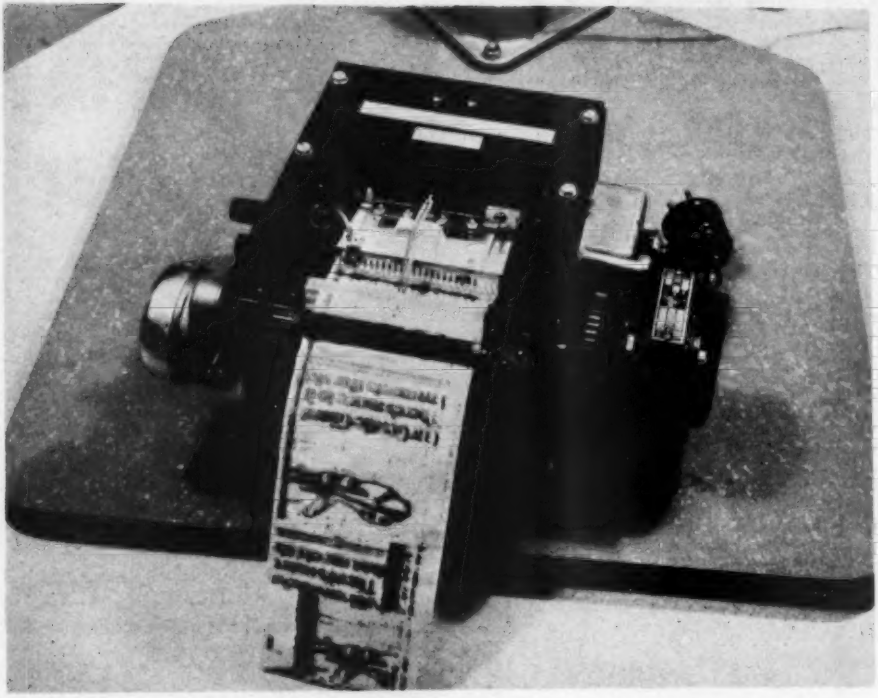

A FAST SCAN FACSIMILE SYSTEM WITH SSTV COMPATABILITY

Mechanical systems of picture presentation popularly referred to as facsimile are not new to amateur radio. Such systems were used extensively back in the 1920's when scanning discs produced the pioneer equivalent of SSTV on the 150–200 meter band, where it was then legal. The relegation of all facsimile to the VHF placed most interested experimenters in a communications vacuum and has probably been the major factor in discouraging amateur facsimile.

The presently legal system known as SSTV, though facsimile, seems limited to TV methods; however, the perimeters of the system are readily adapted to other systems of facsimile transmission and reception which are not limited by the 8-second useful persistence of the P-7 phosphor.

When so adapted, these other systems immediately become as legal on the DX bands as SSTV, thus broadening the potential horizons of those experimenting with these facsimile systems. The development of the perimeters of slow scan and their eventual legalization represent the great contribution of Copthorne McDonald[1] to the amateur art.

Typical fax pictures from the author's fast scan unit.

Most any system of mechanical readout may be adapted to the 15 line per second requirement of current SSTV. The drum system will produce beautiful pictures when carefully built, even when the drum is a rolling pin borrowed from the kitchen, as witness the systems described by Anderson[2] and McKnight[3] for use in the reception of weather satellite pictures.

Little besides the drum and lead screw speeds and the video diode polarity need be changed to produce excellent slow scan pictures. However, such systems might not prove too attractive because of the necessity to retool between each picture, and the expense of the paper. Electrostatic paper under the same conditions is less expensive, but has the same "retooling" disadvantage.

After several years experience with amateur APT weather satellite readout using several different systems, the writer adapted the continuous readout helix blade principle used in many commercial facsimile systems to home fabrication from readily available materials. The adaptation worked beautifully, using the inexpensive electrostatic papers available to experimenters in small lots.

When a lull in APT interest was brought on by the premature demise of the excellent weather satellites ITOS-1 and NOAA-1 and the launch failure of ITOS-B, I became interested in adapting the latter system to compatability with current SSTV perimeters as developed by McDonald and now used universally.

The big advantage of such a system is to provide legal worldwide facsimile capability to those wishing to build their own facsimile equipment. As long as the transmitted signals follow the format of SSTV, these activities are obviously perfectly legal despite the equipment used for generating and receiving the signal. Furthermore, by the simple expedience of slowing the "vertical" scanning rate to send and receive the pictures in double or quadruple the present 8-second limit of the useful brilliance of a P-7 phosphor, the number of lines per picture and thus the resolution can be doubled or quadrupled. (It is recognized that other perimeters such as spot size must also

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be optimized in order to get the full improvement in resolution.) With the present wording of FCC regulations, such experimentation must await the development of amateur interest in such increased picture resolution.

The continuous readout helix blade principle allows the paper to roll continuously off the roll. This is scanned horizontally and then flows continuously out of the machine. Using electrolytic paper, the scan can be viewed immediately on completion of the individual line.

The basic principle of the system is at first more obscure than that of drum or scope readouts. It becomes readily comprehensible if one will get a cardboard tube, such as the core of a paper towel roll or a rolling pin from the kitchen, and wrap a single spiral turn of string or wire from end to end on it. Holding this tube parallel to the edge of a ruler, the tube is then rotated and the movement of the point of contact watched. One complete rotation of the tube will move the contact point the full length of the ruler, and represents one scan line when electrolytic paper is pulled slowly at right angles between this point of contact.

Construction Details

Construction may follow many forms. The box may be made of Masonite as in my APT readout apparatus, or in a 10.3 x 12.9 x 15.4 cm (4 x 5 x 6 in. Bud #CU-729-B) steel box as in the Fast Facsimile readout. The paper compartment or humidor could be in a plastic box with a slit for paper exit at an appropriate level and the mechanical printing complex arranged outside on suitable supports. The sole requirement in such case would be that the paper must not dry out while passing from the slit to the printing blade/helix combination – not probable at a rate of 6.5 cm in 8 seconds, but a situation to be reckoned with, nevertheless, where interpicture waits take place.

If the cabinet is to be made of Masonite one may well use 0.7 cm (¼ in.) tempered Masonite held together by 4-40 machine screws 2 cm (¾ in.) long, screwed into holes drilled to the exact original diameter of the screw. To further firm up the cabinet, the screws should later be individually removed,

"Will-hold," "Glue-bird" or "Elmer's" glue placed in the hole, and the machine screws again screwed into place.

In the metal box of the fast fax readout, the partition was placed at the approximate midpoint with the slit for the paper 2 cm (¾ in.) from the top. Both the top and the bottom of the cabinet were removed and cut so that one portion of each covered the paper compartment. The bottom cover was then attached permanently with self-tapping screws and epoxy cement. The support for the paper was fashioned from two galvanized angles, two arms of which were superimposed to form the base of a U-shaped bracket. A drill and hacksaw aided by a rat-tailed file enabled the formation of the necessarily slanted holes for the reception of the alfax paper spindle (Fig. 1).

An area approximately 9.6 cm (3 x ¾ in.) deep was cut from the upper front area of the front of the metal cabinet with a nibbler, and a 1.3 cm (½ in.) width of 0.65 cm (¼ in.) plexiglass was bolted in so as to leave a 0.65 x 7.7 cm (¼ x 3 in.) slit for the printed paper to pass out to the paper puller.

One of the two compartments of the cabinet is a "humidor" for the maintenance of the wet paper. The other is the printing chamber. The latter was originally planned as a humidified chamber, but this has been found unncessary and seems undesirable, as the humidity might affect adversely the metal components of the printing complex. The humidor, whether made of Masonite or in a steel box, was first water-proofed with two coats of marine fiberglass paint (epoxy resin – not monoepoxy) as was also the printing compartment. After these coats had set, the paper compartment was given an additional coating of hot paraffin because it was found that water in the bottom caused the questionable grade of epoxy to turn white. The top of the humidor was made of plexiglass (or the original metal cover) held firmly in place by removable screws. Some sort of device must be included to prevent paper runaway. I wedged felt brakes at the ends of the spool in my APT model, which kept the spool tight enough to prevent runaway but loose enough to permit the paper puller to keep the paper flowing without variation. The device indicated in Fig. 1, made of a 2.54 cm (1 in.) width of shim brass, was used for this purpose in the fast fax readout.

The upper part of the central partition above the paper slit is made of plexiglass, as is also the lower portion, and is held in place to the walls with brass angles. This upper portion of the partition in turn becomes the support for the blade electrode supporting shelf, which is held firmly in place just above the paper entrance in the printing chamber by two small brass hinges on the upper side of the 0.65 cm (¼ in.) Masonite or plexiglass which supports the blade electrode exactly above the center of the drum.

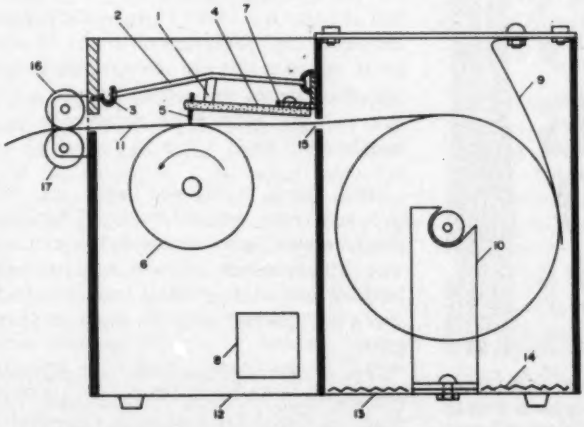

Fig. 1. Diagram of the mechanical layout of the Fast Facsimile recorder.

Facsimile QSL received from K9BTU while reading the mail on SSTV. Since the machine is a direct recording device, all signals received are processed. Note the array of partial frames below the first picture.

The printing blade is a 1.3 cm (½ in.) strip of stainless steel three inches long fastened to the edge of the 3.9 x 5.2 x 0.65 cm (1½ x 2 x ¼ in.) plexiglass blade support. 0.3 cm (1/8 in.) holes are drilled into the edge, duco cement inserted, after which 4-40 machine screws were forced in. After a few minutes these were removed and the cement was allowed to dry. This in effect threaded the hole. The blade was attached by these same machine screws threaded into the holes. The blade rests on the top center of the helix. Desired levels of residual tension are applied to the shelf by several rubber bands originating above the point of hingement and extending to the front of the compartment. These are held in place at both ends by small hooks, and tension is maintained and varied by a strip of 0.65 cm (¼ in.) Masonite or plexiglass held passively in place between the hinged blade support and the rubber bands. Considerable tension is necessary in order to print smoothly on the paper; however, too much tension results in paper shredding and cutting.

The drum should be of insulating material about 3.9 cm (1½ in.) in diameter. There is nothing sacred about this size, however, and available materials should dictate. End pieces with exact centering should be turned from most any available material. I used fiber glass obtained from war surplus items throughout, and cemented them with epoxy. The length of the drum is controlled by the width of the paper decided upon. The most logical size of paper is 7.1 cm (3¾ in.) wide and was chosen to take advantage of the $1.50 price break between this and the next larger size. The drum length was a little over 9 cm (3½ in.) and the spiral helix occupied a total length of 6.8 cm (2 5/8 in.).

The spiral helix was made of #22 nichrome wire bought from a laboratory supply house. Any relatively nonstretchable wire of equivalent size and behavior may work equally well providing it does not rust and is not reactant with the chemical in the paper.

The drum must turn in the counterclockwise direction observed from the (right) end, while the spiral must be made clockwise as indicated in the diagram. This is an essential

Operating SSTV is easy.
☐ True or ☐ False

How much do you really know about the newest activity in amateur radio? Take this 3 minute TRUE-FALSE quiz and see.

		T	F
1	A slow scan television picture is similar to that projected on TV.	☐	☐
2	Motion can be portrayed on slow scan television.	☐	☐
3	To broadcast slow scan television just add a Robot monitor and camera to your present station. No other equipment is necessary.	☐	☐
4	Slow scan occupies no more space on the band than an audio signal.	☐	☐
5	Any licensed amateur radio operator, except Novice, may operate SSTV.	☐	☐
6	$295 each for a Robot SSTV monitor and camera is the lowest price in the world for SSTV equipment.	☐	☐
7	Robot guarantees your satisfaction with all Robot equipment, or your money will be refunded.	☐	☐
8	New SSTV operators all suffer from lack of sleep.	☐	☐

ANSWERS:

1. **False.** The slow scan television picture is a greenish-yellow color which takes 8 seconds to transmit. Like radar, the image should be viewed in a darkened room for best results. Also like radar, as the picture progresses it has the appearance of being painted onto the screen by a bright writing line except that the line moves from top to bottom. 2. **False.** Motion results in a blurred picture. 3. **True.** Robot equipment is compatible with all brands of amateur radio equipment and antenna systems. 4. **True.** The SSTV signal contains frequencies ranging from 1200 Hz to 2300 Hz. Therefore, it is comparable to an audio signal. 5. **True.** 6. **True,** as far as we can determine. 7. **True.** 8. **True.** New SSTV operators are so enthusiastic about the fun of operating slow scan television, they hate to quit.

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feature for correct picture orientation. The wire is passed through a short diagonal hole to the end of the drum, where it is anchored to the end with a self tapping screw. It is then pulled tight, arranged in position on the drum where it is caught in the strong grip of a husky pair of long-nosed pliers. By twisting, the wire is tightened and the end then secured around a second self tapping screw. One end must eventually be connected electrically to the 0.65 cm (¼ in.) shaft which serves as the drum axis. The center of the helix must be exactly midway between the origin and insertion of the two ends and on the opposite side of the drum. It should be tight enough not to require cement to hold it in place.

The ball-bearing assemblies which support the drum are mounted in the two ends of the cabinet at a position dictated by the location of the other active components of the printing chamber. In the metal model the bearings were cemented in holes in small pieces of Masonite with epoxy cement, and these were then bolted in the appropriate position inside of the cabinet. The holes receiving the ball bearings must be immediately below the printing blade and so positioned that the top of the helix is on the same level as the paper intake and exit slots. The bearings should be snug and tight. They may be held firmly in place in Masonite models by drilling a small hole beside each and then inserting an overlapping machine screw and tightening it firmly with a nut. The spring blade from an old relay riding against the shaft provides the electrical connection to the spiral wire of the helix.

The drum motor is the Bodine KYC-23, 3500 RPM synchrons, 9.5 watt job used in several industrial applications. They are available as industrial surplus from Herbach and Rademan, Inc., 401 East Erie Avenue, Philadelphia PA 19135; current price $4.95. This motor requires a set of gears to give a 4:1 speed reduction from 3600 RPM to 900 RPM. Suitable items are Pic Design Corporation's G 57-12 along with their G 41-48, which will give the required 15 RPS or 900 RPM. Their address is P.O. Box 335, Benrus Center, Ridgefield CT 06877. The price currently is $11.70 plus postage and tax which should be included with the order.

The same supplier as for the Bodine motor has numerous synchronous motors at 1800 RPM. These might be substituted with a 2:1 gear reduction system. Hurst also makes a 900 RPM motor which would obviate the gear problem, but the price is prohibitive in most cases and the motor is larger than needed.

The drum motor is mounted on the right hand end of the printing compartment. The Bodine motor is supported by three of the four mounting bolts, the originals of which have been replaced with 6.4 cm (2½ in.) replacement bolts and spacers. The fourth position allows the large gear on the drum shaft to reach the small one on the motor shaft.

The paper puller assembly uses a 3 watt synchronous motor turning at 15 RPM, which with the described rubber rollers give the desirable square picture for an 8 second frame. Any other 3 watt synchronous motor of appropriate speed would probably work, though the motor is working very near its maximum capacity and a Hurst 10 watt model CA might be more desirable.

The paper puller consists of two lengths of 0.5 cm (3/16 in.) brazing rod covered with 7.7 cm (3 in.) lengths of rubber tubing. If these perimeters are changed, then the motor speed must also be altered to maintain the correct speed of paper advance. The brass rods are supported either by brass angles or brackets. It is desirable but not mandatory to turn the rods down at the ends to fit 0.3 cm (1/8 in.) holes in the respective brackets. I used appropriate sizes of spaghetti as coupling to the motor.

The position of the motor was dictated by the position of the paper exit slit and the direction of motor rotation. The top roller is driven when a clockwise motor is used on the left end, while the lower rod must be driven under the same conditions if a counterclockwise motor is used.

This paper puller motor must run from the light mains, but must never be in operation when the drum is turned off and tension is applied to the paper by the printing blade. After several times tearing up the paper, I prevented a recurrence by turning off the paper puller and the video input to the blade electrode with a 110V ac

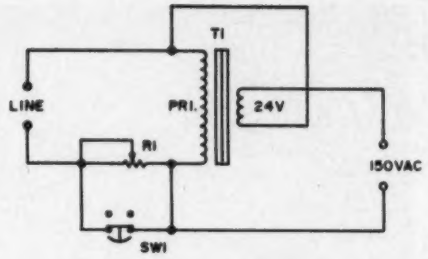

Fig. 2. Autotransformer to raise line voltage to 150 volts to obtain good synchronization from the Bodine motor. R_1 should be adjusted so that when SW_1 is pressed the motor is only slightly slowed.

relay energized by being connected in parallel with the drum motor. Thus, whenever the drum motor supply turns off, the other two functions are also stopped.

Synchronization

It goes without saying that the 60 Hz ac controlling the drum motor must be synchronous to that controlling the camera, the flying spot scanner, or the drum at the transmitting station. This condition is usually true within the continental United States and Canada, but is not when a tape recording is being used at the sending end, nor is it true with most foreign countries. 60 Hz will not necessarily be in sufficiently perfect sync to print out pictures though I have received successful pictures from wide areas of the country simply by running the drum motor from the ac line. This does not mean they will be framed correctly. Framing may be accomplished by momentarily reducing the ac voltage on the drum motor until sync is lost, which allows the drum to lag until framing is accomplished. For good sync, the voltage on the drum motor should be around 150 volts. This may be obtained from the ac line by connecting a 24V filament transformer so that it operates an auto transformer (Fig. 2). The secondary must be reversed if the resulting output voltage is less than line voltage.

If the pictures are to be tape recorded before being printed out, then a dual track recorder is necessary. On the left track the 60 Hz line is taped simultaneously with the received slow scan signal on the right track. If the two ac lines are synchronous, then the picture will be synchronous for any later printout. When thus printing out from a tape a 15W, 60 Hz ac amplifier or equivalent must be used to drive the motor from the left track of the tape recorder simultaneous with printout from the right.

A much better and more versatile system, however, is the tunable frequency standard. This consists of a very stable variable frequency oscillator such as a unijunction or voltage sensitive integrated circuit as shown in Fig. 3, operating at, say, 60 kHz, which is then "counted down" to 60 Hz with three decade counters, such as the SN7490s which are presently so inexpensive on the surplus market.

The 60 Hz obtained from the countdown is square wave and must be turned into sine wave, since the Bodine and Hurst motors definitely object to square wave. This is done by feeding the output into a 15H choke as inductance resonated at the output end by a condenser to ground. The junction

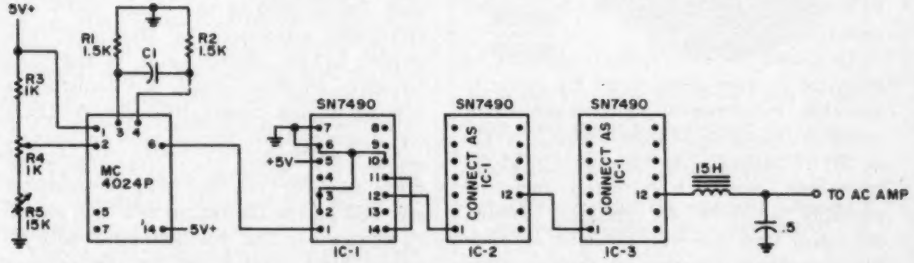

Fig. 3. The variable frequency synchronization system worked out by W6KT for his SSTV monitor, modified for use with the fast fax. R_1 and R_2 limit the range while C_1 and C_5 are used to set the frequency for exactly 60 Hz with R_4 at midscale.

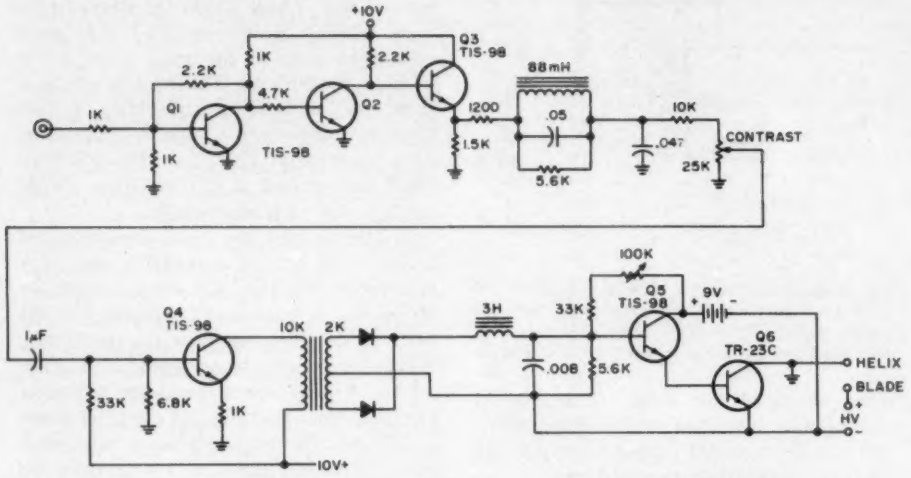

Fig. 4. The video circuit consists of the hard limiter Q_1–Q_3 and a conventional McDonald L/C discriminator. This is followed by an amplifier, a rectifier, filter and the paper marking amplifier. Some of the former circuits may be eliminated by use of the video circuits of a conventional SSTV monitor, in which case one would probably connect in at the contrast control.

of the choke and condenser shows perfect sine wave and is ready for amplification to the 150V at which the motors hold synchronization best. When the voltage on the motor drops below 130V, various synchronization anomalies begin to occur.

If carefully constructed, this makes a very stable standard which can be adjusted to exact synchronization with the received signal, generally even when ac operated tape recorders of the better types are used at the transmitting end. Replacement of a tape recorder motor with a synchronous one would probably be near optimum. Little can be done with the signal from the dc operated cassettes.

Of course, the ideal system would be for everyone to have absolute 60 Hz power to run their frequency sensitive apparatus. A standard frequency obtained from a crystal at, say, 6 MHz and divided down to 60 Hz by decade counters is extremely stable and probably represents the optimum. Briefly, the signal from a 6 MHz oscillator is fed at low impedance successively through three sections of a hex inverter to produce a square wave. This squared 6 MHz wave is then fed into five decade counters successively, coming out at 60 Hz. To improve the level it then goes into the last three sections of the original hex inverter. What comes out is square wave and the previous remarks hold in this arrangement as well.

In order to set the signal of the 6 MHz crystal to exact frequency, some signal from the crystal oscillator must be taken through a "divide by six" integrated circuit to give 1 MHz output. This should then be used to zero the oscillator with WWV at 10 MHz.

Video Circuitry

The video circuit feeding the blade and helix are shown in Fig. 4. It consists of a hard limiter feeding the classic SSTV discriminator introduced by McDonald. The output of the discriminator is fed to a transistor amplifier which is a transformer coupled to the demodulator diodes. These are connected to give a positive output, which then drives the Darlington paper driver amplifier. The whiteset potentrometer sets bias on the Darlington and thus should be adjusted to the threshold point with no signal. Black level is set by the contrast control. These perimeters are the opposite to those of the usual SSTV monitor. The paper marking voltage should be of about 40V dc

"Peeping Tom," an intriguing fax picture, even though the window is obscured by QRM.

shunted with 200 μF of electrolytic capacitors to guarantee the high current capacity required during printing. Hard control of the voltage is necessary since the current varies from zero to 200 or even 300 mA. Be absolutely sure there is no ac hum in the power supply.

Notes on Operation

When operating the fast fax, unless you have a variable standard you should note if the transmitting station is sending live copy. If he is not, or cannot do so, there is little use in attempting picture exchange. The signal is tuned in on normal voice, the motor is turned on, the contrast adjusted to produce copy, after which the margin is adjusted by the momentary loss of sync button (Fig. 3). The pictures should then roll out into your lap at an unnerving rate. Fortunately, experience will cure this initial adverse effect.

The printing surface of the blade requires frequent care. After every run when putting the fax away the blade should be lifted and the surface cleaned with water, and perhaps

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The skew in this fax picture was caused by a tape recorder at the transmitting end.

also with emery cloth. This will prevent a smudgy appearance when collected pigment accretions begin behaving as crayons.

As normal printing occurs, the blade deteriorates due to the necessary electrolysis which bleeds off positive iron ions into the paper. The iron ions unite with the chemical in the paper to produce the mark. After a time the blade may become uneven. Such a blade may be rejuvenated by grinding on a perfectly flat carborundum stone until any bumps are removed. The degree of printing deterioration determines the necessary frequency of this operation.

Threading the paper is a bit of a chore. Perhaps the simplest way is to expose the end until it dries, then glue on a thin strip of 12.8 x 17.8 cm (5 x 7) card to use as a "needle."

Pictures are considerably improved in appearance if they are ironed with "cotton heat" just before they are completely dry. They should feel dry to the fingers but still contain considerable water. When allowed to dry too much, the ironing will tend to wrinkle the paper.

In use, I place paper towels in the bottom of the humidor compartment which are then saturated with water to keep the paper from drying out. Each time when beginning a run a length of paper left in the front printing compartment will have dried out. This must be pulled out until the rollers make contact with the wet paper. The paper pulls easily when the dry is between the rollers, and it will slip until it is in contact with wet paper.

Electrolytic printing paper is available from Alden (Alfax Paper and Engineering Co., Inc., Westboro, MA 01581) in single roll quantities; there are several kinds to choose from. I have found the Alfax A-2 to be most satisfactory. Alfax A2-41 gives much better depth without gamma correction circuits, operates more smoothly, and prints in black and white, but unfortunately fades and discolors in time. Alfax A paper is more sensitive, but does not make the clean, crisp picture that the A-2 paper produces. It requires 50% more drive from the video circuits.

Much improvement is yet to be made in the video circuits, the type of paper used, as well as in other parameters of the circuits and mechanics. Only the basic circuits and mechanics are presented here as an invitation to improve and perfect the system.

Appreciation

I wish to especially note the contributions to this article of Virgil Neher W6KT, a fellow APT weather satellite enthusiast, with whom the various circuits were regularly discussed. Many of his ideas are incorporated into the design, particularly of the supportive circuitry, and without him the final form would have been much different if it had ever been brought to fruition.

. . .W6WMI

***Please enclose an SASE with all inquiries.**

References:
[1] McDonald, A new narrow band image transmission system. Part 1. *QST* August 1958. Also: An improved system for slow scan image transmission. Part 1. *QST* January 1961.
[2] Anderson, Amateur reception of weather satellite pictures transmission. *QST* November 1965.
[3] McNight, Evolution of an amateur weather satellite station. *QST* April 1968.

Roland L. Guard Jr. K4EPI
750 Lily Flagg Road
Huntsville AL 35802

THE EASY WAY TO SIX AND TWO METER HIGH POWER

Having built a few power amplifiers, I have learned via the school of hard knocks of the almost unavailability of those goodies known as high-power parts. These include meters, transmitting tube sockets, transmitting tubes, switches, blowers, large transmitting capacitors and heavy-current centertapped filament transformers.

After collecting all the parts, then there is the problem of finding a suitable cabinet enclosure, drilling a chassis and cutting meter holes in those 1/8 in. steel rack panels.

The amplifier described here solves all of the headaches described above, as it is ready-made and on the surplus market for $25.

The unit is the Signal Corps AM-8D/TRA-1 FM Amplifier, and with the addition of two fixed capcitors, will operate on either six or two meters FM. Unmodified, it covers the range of 70–100 MHz with a power output of 200W. It measures 10½ H x 16 W x 11 D in. and is not too large for the average table. The schematic is shown in Fig. 1.

The finals are a pair of 4E27/8001s in Class C usable on FM. Bear in mind that the 200W rating is because the 4E27s have a frequency cutoff of 75 MHz and must be operated at a reduced rating above that frequency. 1 kV is used on the plates above 75 MHz and 2.5 kV can be used on six meters, for a power output of 600W.

The panel meter reads 0–30 mA grid drive, 0–600 mA plate current and 0–3000V dc for the high voltage. One percent resistors are used for the various meter shunts.

The panel meter has a clear plastic protective cover, which should be removed if you want to see the meter. It was probably clear in 1950, but mine wasn't. On the opposite side is another meter hole and plastic cover. It probably held an rf ammeter which is missing. This plastic cover was left in place to keep the chassis pressurized.

The squirrel-cage blower is used as an exhaust and blows air *out* of the cabinet – right in your face! The blower can be turned around to blow cool air on the finals, however. A mesh filter is mounted over the intake opening on the chassis and a spare filter is mounted on the other side. As is, the cabinet is pressurized, although copper screen wire is needed to TVI-proof the intake and exhaust openings.

The unit has a hinged top cover, high voltage interlock switch, two very nice pilot light assemblies, three OD3 VR tubes, 5V CT, 15A filament transformer, 12V dc antenna T-R relay and SO-239 standard antenna connectors. The blower and filament transformer alone are worth more than the price of the amplifier.

For conversion to six meters FM, add two 10 pF 6 kV capacitors in parallel with the plate tank capacitor. For two meters FM, add two 35 pF 6 kV capacitors in series with the plate tank capacitor. See Figs. 2 and 3 for this modification.

The Signal Corps manual for this unit is TM 11-2601, should further information be desired.

The chassis-mounted thermostat should be jumpered or removed, as after two hours

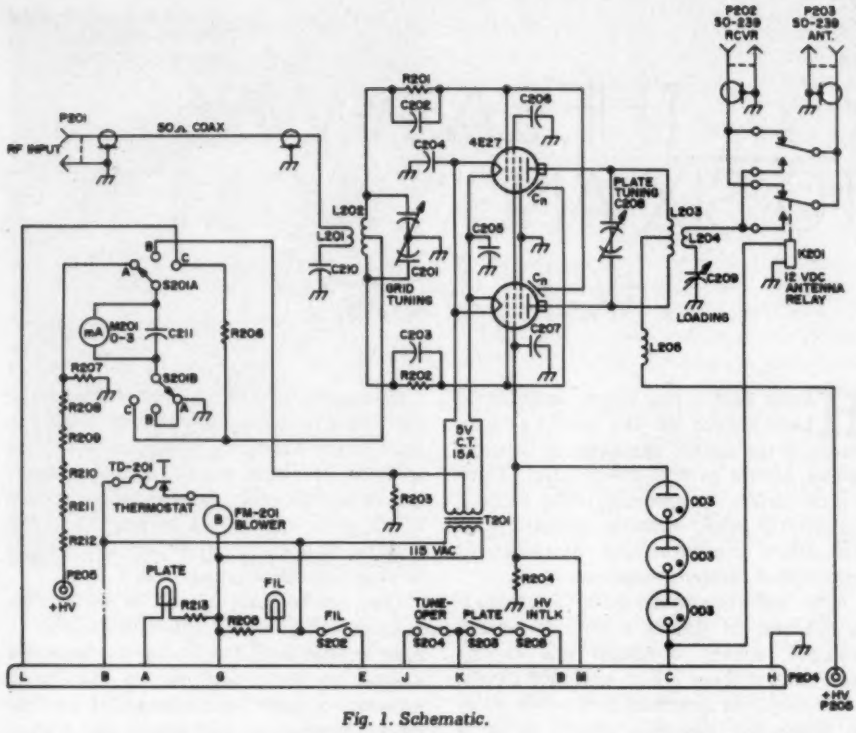

Fig. 1. Schematic.

Table I: AM-8D/TRA-1 Parts List

CAPACITORS:
C201 3–50 pF dual variable
C202-C205 .005 mF 1 kV
C206-C207 .002 mF 1 kV
C208 7–35 pF dual variable
C209 5–50 pF variable
C210 25 pF 1 kV
C211 .002 mF 1 kV

RESISTORS:
R201, R202 10K, 4W
R203 .15 ½W
R204 500K 1W
R205 600 4W
R206 2.5 ½W
R208-R212 200K 2W
R213 600 4W

COILS:
L201 grid coupling
L202 grid tuning
L203 plate tuning
L204 antenna coupling
L205 plate rf choke

PILOT LIGHTS:
PL201, PL202 115V, type S6

CONNECTORS:
P201 rf input
P202 Receiver antenna coupling
P203 Antenna coupling
P204 External power
P205 High voltage

SWITCHES:
S201 Meter circuit selector
S202 Filament ON-OFF
S203 Plate ON-OFF
S204 Tune-operate
S205 High voltage interlock

RELAY:
RL201 Antenna transfer, 12V dc

TRANSFORMER:
T102 Filament, 5V CT 15 A

EXHAUST FAN:
FM201 Squirrel-cage blower, 115V ac

THERMOSTAT:
TD201 Blower control

METER:
M201 0–3 mA dc

TUBES:
V201, V202 4E27/8001
V203-V205 OD3/VR-150

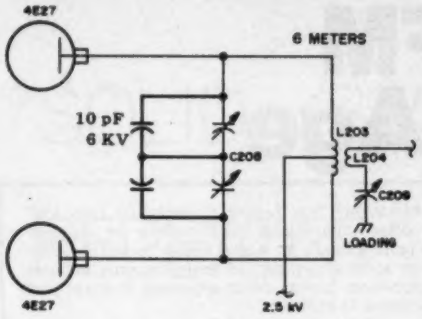

Fig. 2. For 6 meter operation, modify plate only, by adding (2) 10 pF capacitors in parallel with C208, as shown.

mine never did turn on the blower. The blower when running is very quiet, anyway. The blower is on an adjustable mount and should be slid away from the side of the cabinet as far as possible to increase the air flow through the unit.

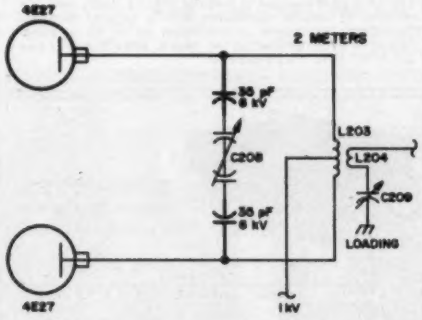

Fig. 3. For 2 meter operation, modify plate tank only, by adding (2) 35 pF capacitors in series with C208.

If you're worrying about replacing the finals in the far future, be advised that 4E27s were going for $1 each at a recent Florida hamfest.

The 2½ turn plate tank is silverplated, and if it is tarnished, it can be cleaned bright again with your XYL's silverware polish.

Should you desire not to put the unit on six or two meters FM, extensive reworking will yield a 80–10 meters CW kilowatt in Class C.

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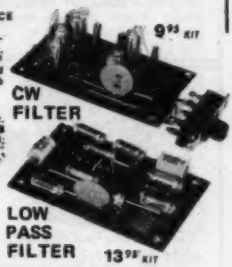

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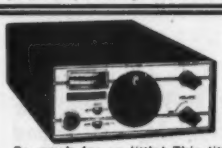

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TPL502B	1 to 3W	45W	2M	$130.00
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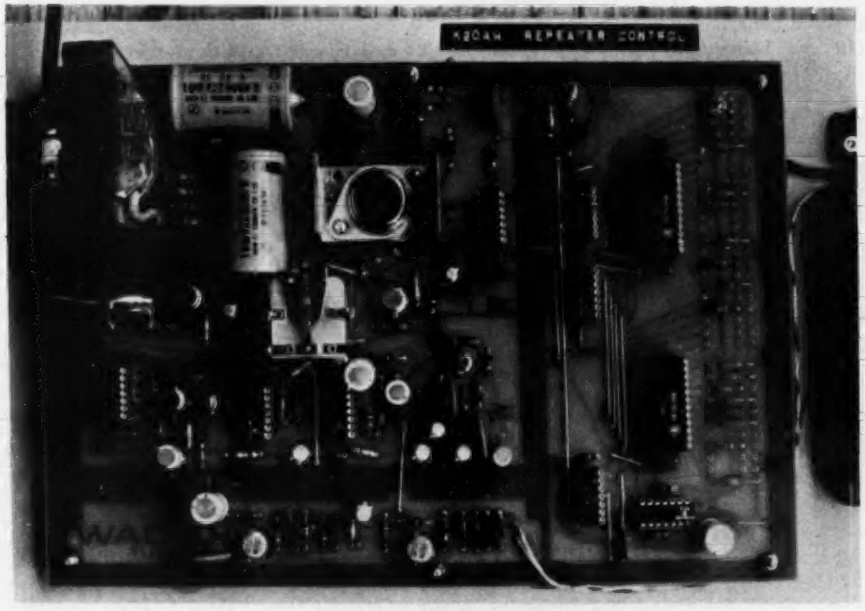
SOLID STATE REPEATER CONTROL

A short time ago we presented our integrated circuit CW ID generator, and promised a solid state repeater control to go with it. In this article we describe two such controls, a simple one for use without the ID and one for use with it. Both circuits make use of the 741 operational amplifier as a comparator relay driver, and you might want to review our earlier article on COR and tone decoder circuits using this IC – ("741 Op Amp COR and Tone Decoder Circuits," *73* Magazine, July 1972, page 83).

Figure 1 shows a simple COR and timeout timer we designed to go with a railroad Motrac receiver. In this receiver Q22 is a noise detector which normally drives Q23, an audio switch which then turns the audio amplifier on and off. The voltage at the emitter of Q22 varies from about +7 volts when fully squelched to about +9.4 volts when unsquelched, but the actual squelch



Repeater control CW/ID.

opening occurs in a narrow range about +9.1 volts. We decided to break the normal squelch at R98, bring out the squelch voltage, process it a bit, and then use the same voltage to drive both the squelch and the COR.

The threshold voltage is set by the 5K pot in the emitter lead of a HEP52 transistor; we decided to set the threshold at about +8 volts. When the squelch voltage drops below this value, this transistor is biased on, which in turn biases on the second transistor. The collector of the second transistor is now at about 0 volts and this voltage is fed back to the Motrac to turn off the audio by turning on Q23. At the same time we get about 0 volts fed to the two diodes in the input circuitry of the op amp.

Since the top end of diode D1 is set at about 0 volts, this diode is turned off and pin 3 of the op amp IC is at about 0 volts. But pin 2 of the IC is slightly positive because of the 220K resistor to +13.6 volts. As a result (see our previous COR article) the output of the op amp IC is near ground, and the relay is open.

Now suppose a signal arrives. The squelch voltage from the Motrac goes above the threshold voltage, and both transistors in the COR are biased off. The audio control voltage going back to the Motrac is now positive, which turns on the Motrac audio. At the same time, the voltage to diodes D1 and D2 goes positive also. After a slight delay, the 10 μF capacitor charges through diode D1 and pin 3 of the op amp goes positive. Since pin 3 is now more positive than pin 2, the output of the op amp goes positive and the relay pulls in.

At the same time, diode D2 becomes reverse biased because its cathode is positive. The voltage at the top of C2, which was close to zero til now, starts rising. After about two minutes this capacitor charges to the point where the voltage at pin 2 of the IC is larger than the voltage at pin 3, and this makes the relay drop out. This gives us about a 2 minute timeout.

When the received carrier drops, the audio control voltage back to the Motrac drops quite fast and mutes the audio. C2 discharges back to near 0 volts through diode D2 to reset the timeout timer. But C1 stays charged for about a second or two, which delays the drop-out of the relay. This prevents excessive keying of the transmitter after every transmission, but it also has another interesting side effect. When the repeater is timed out, it comes back on for a second or so when the received signal drops, to tell the other stations that the timer is reset and the repeater available. In this way

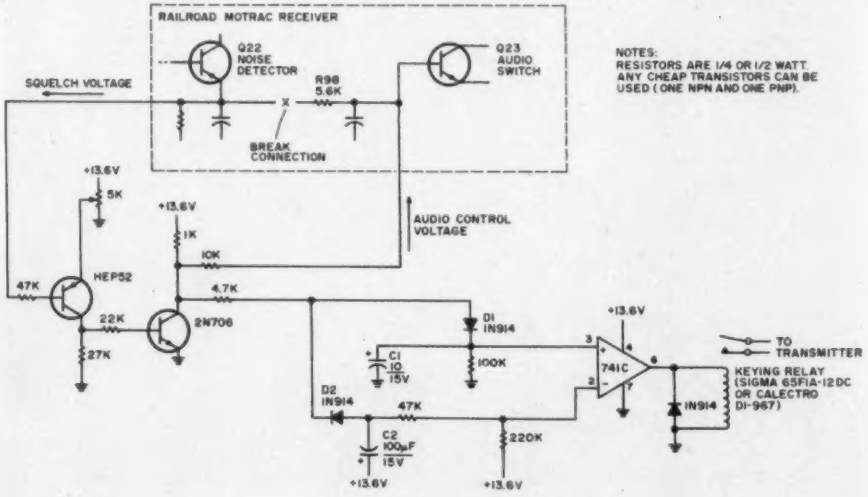


Fig. 1. Simple COR and timeout timer.

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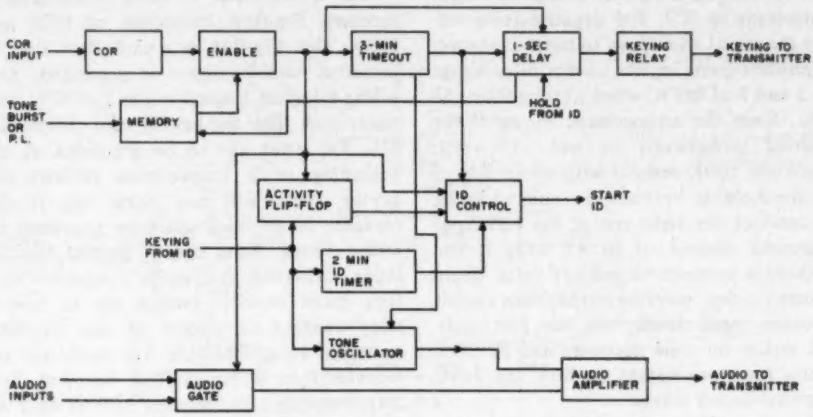

Fig. 2. Repeater control block diagram.

you don't have to keep testing to see whether the machine is available.

The Timeout Timer

The block diagram for a more complicated repeater control is shown in Fig. 2. This one includes a COR designed for tube receivers, memory circuitry for tone burst or PL, a three-minute timeout timer, ID control circuits and timer, and an audio buffer system. Because of its increased complexity, we have designed a printed circuit board for this system.

Figure 2 gives an overall view of the control. The COR at the upper left works in combination with the tone burst or PL memory to energize the keying relay. When the received signal disappears, the one-second delay causes delayed dropout. The three-minute timeout timer releases the relay after three minutes of transmission.

An activity flip-flop keeps track of repeater activity, and causes the ID to start at roughly two minute time intervals as long as the repeater is busy. The repeater IDs under four conditions: at the end of the first transmission in a series; roughly two minutes apart thereafter (though always waiting for the end of a transmission); after the last transmission in a series; and after a timeout. In those repeaters where the ID is desired even when there is no activity, the activity flip-flop can be disabled; in this case the ID will turn on every two minutes.

The tone oscillator generates the ID tone. But it has an input from the timeout timer, which causes the pitch of the ID to fall and then rise after a timeout. This makes it clear to the offender that he goofed.

At the bottom of the block diagram is the audio path. The control provides two audio inputs, one of which is inverted in the amplifier. Thus they can be used to mix two single-ended inputs, or even for a single balanced input. The audio gate is controlled by the COR signal, which mutes the audio as soon as the carrier drops. This causes a very short squelch tail. In this way it is possible to take the audio directly from the discriminator, or else disable the squelch on the receiver. The audio from the audio gate is then mixed with the ID audio in the audio amplifier, and sent to the transmitter.

Figure 3 shows the detailed diagram of the logic and timer circuits. The COR is located in the upper left corner, and uses a 741C operational amplifier. It is designed for a negative-going voltage at the COR terminal, with a threshold lying between +1 volt and about −10 volts, such as you might get from the limiter current test jack of a tube receiver. The COR input is activated whenever the dc voltage at pin 3 of IC3 goes more negative than pin 2. The two resistors connected to pin 2 provide a reference voltage of about +2 volts, and the 100K pot provides an adjustment for the COR level. To adapt the COR input to work with other

input levels you need only change the input connections to IC3. For negative-going voltages the input should go to pin 3 as shown; for positive-going inputs merely interchange pins 2 and 3 of the IC when putting it on the board. Keep the arrangement shown if the threshold is between +1 and −10 volts; replace the 100K resistor with about 22K if the threshold is between +1 and +3 volts, and connect the right end of the 100K pot to ground instead of to +5 volts if the threshold is between +3 and +10 volts. There are many other ways to modify this circuit for other input levels; see our previously cited article on tone decoders and IC COR circuits for more details on how the 741C integrated circuit works.

The output from pin 6 of IC3 is normally at about +10 volts, which reverse-biases the PNP transistor connected to the output. Since there is then no current through the 330Ω resistor, the collector voltage of the transistor is about zero. When a received signal appears, the IC output drops to near ground, which turns on the transistor and makes the collector go up to about +5 volts; this is interpreted as a logical 1 signal by IC7a.

The other input to IC7a comes from a memory flip-flop consisting of IC7c and IC7d. This flip-flop sets each time the TB (external enable) input is grounded, providing a logical 1 signal to pin 2 of IC7a, and resets each time the keying relay drops out. The TB input has to be grounded at the beginning of a transmission or else the keying relay will not come on. If the repeater is an open machine requiring no access tones, then simply ground the TB input. Otherwise it may be connected to a tone burst decoder (which has to have a relay contact to ground or else an NPN transistor to ground), or (for *really* private repeaters) to a Touch-Tone decoder. You may connect a PL decoder here as well. As shown, the flip-flop is connected for just an initial PL tone enable; for continuous tone simply remove the connection between pins 9 and 11 of IC7.

The COR signal, gated with the memory flip-flop output, is inverted by IC7a, IC5d, IC5b, and IC5c, and applied through a diode to a 50 μF hold capacitor and to an NPN transistor which pulls in the keying relay. The capacitor provides about a ½ second dropout time at the end of the transmission.

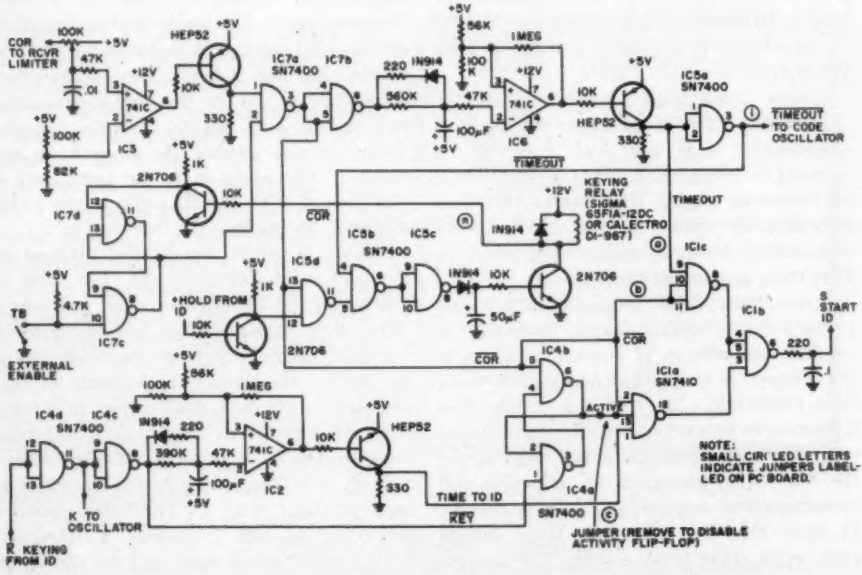

Fig. 3. Logic and timer circuits.

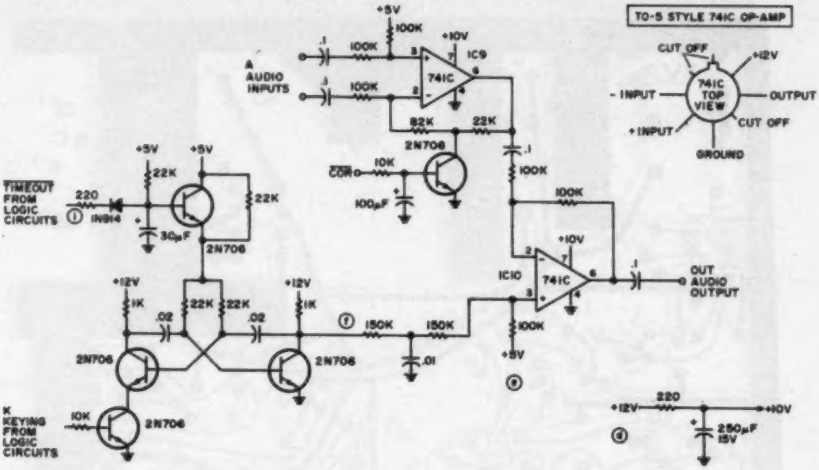

Fig. 4. Tone oscillator and buffer amplifier.

Also applied to IC5 is the hold signal from the CW ID, inverted by a transistor inverter, which keys the transmitter during the ID.

The output of IC7b also goes to the timeout timer. As long as no signal is received, pin 6 of IC7b is near ground, and keeps the top end of the 100 µF capacitor near ground, through the diode. As soon as a signal is received, pin 6 goes positive and starts charging the capacitor through the 560K resistor. After about three minutes (depending on the tolerance of the capacitor – the bigger the capacity, the longer it takes) the voltage at pin 2 of IC6 reaches the voltage on pin 3, and the output on pin 6 swings negative, turning on the output transistor. This generates a logical 1 which goes to IC1c, and a logical 0 which goes to IC5b pin 4, turning off the keying relay. The 1 signal to IC1c starts the ID as soon as the COR disappears after the timeout.

At the lower left of the diagram is another timer, just like the timeout timer but using a 390K resistor instead of 560K. This one provides about a two-minute cycle, which is started every time the ID keys the call. Two minutes later the output transistor generates a logical 1 to indicate that it is time to ID again; this goes to IC1a pin 1.

IC4a and IC4b form another flip-flop, the activity flip-flop. It is set each time the COR is activated, and reset by the keying signal from the ID – thus it remembers whether there have been any transmissions since the last ID. If yes, then the active output line has a logical 1, which goes to IC1a pin 13.

IC1 forms the ID start control logic. As mentioned earlier, IC1c starts the ID when the carrier drops after a timeout. IC1a starts the ID whenever all of the three inputs are logical 1's – that is, when it is time to ID, the repeater has been active since the last ID, and the COR is off, meaning that no carrier is present. This will generally happen when a received carrier just drops, or after the last transmission of a series.

Figure 4 shows the tone oscillator and buffer amplifier. The tone oscillator, at the lower left is just an astable multivibrator which generates a tone at about 1500 Hz. It

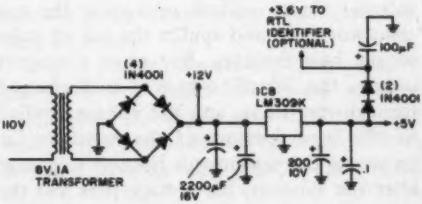

Fig. 5. Power supply.

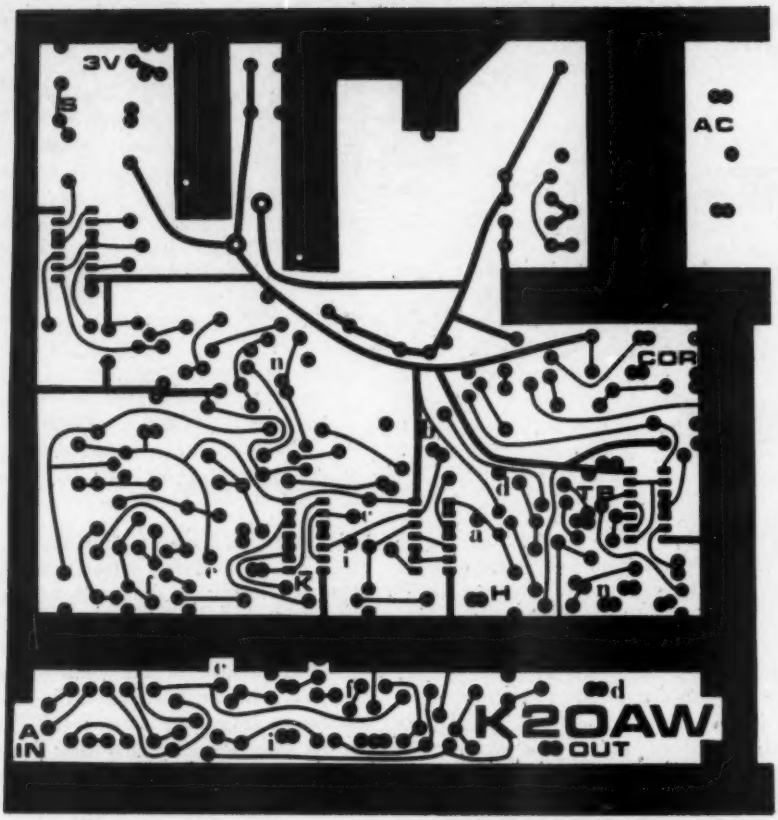

Fig. 6. Printed circuit board layout, repeater control section, 2/3 actual size (copper side).

is keyed on and off by an extra transistor, connected in series with the left-hand transistor of the multivibrator.

The two base resistors of the multivibrator connect to a fourth transistor, which controls the applied voltage. The oscillating frequency depends on the applied voltage. Under normal operation, the top transistor is on and applies the full +5 volts to the base resistors. But when a timeout occurs, the 30 μF capacitor is discharged through the diode, and the voltage applied to the base resistors of the multivibrator drops. As the capacitor is allowed to charge after the timeout, the voltage rises and the oscillator frequency rises back to the normal value.

The square wave output of the oscillator is filtered and applied to pin 3 of IC10, which is the audio output amplifier. Also applied to IC10 is the output of IC9, which is the audio gate.

Two audio inputs, usually coming from the repeater receiver, are connected to the input pins of IC9. With the 100K input resistors and the 82K and 22K feedback resistors, IC9 normally acts as a unity gain amplifier, as long as the transistor connected to the feedback path is open, which occurs only when a carrier is received. As soon as the carrier drops the transistor starts to come on and upsets the dc biasing of IC9 to the point where it just stops amplifying. This then cuts off the audio.

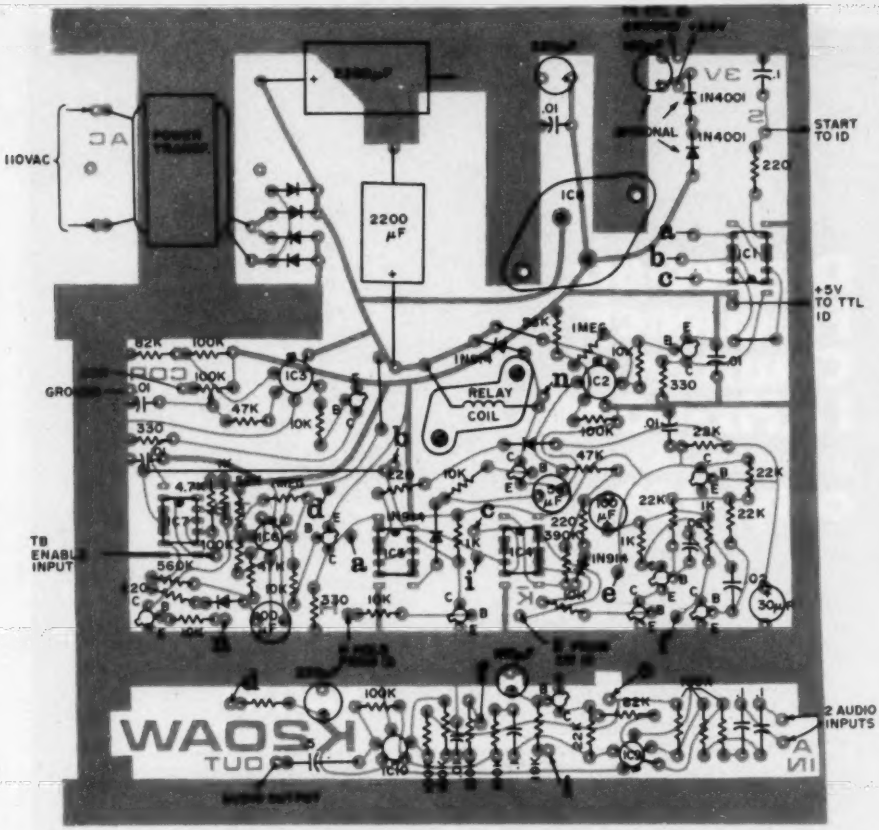

Fig. 7. Parts layout (component side).

The power supply is shown in Fig. 5, and contains a simple full-wave bridge rectifier, capacitor filtering, and +5 volt regulation with IC8. If an RTL CW ID is used which requires about +3.5 volts, then the addition of two diodes and a filtering capacitor will give about +3.6 volts.

The repeater control shown can be used with either the RTL ID described by W7PUG in *73* Magazine in September 1970, or with our own TTL design, referred to earlier. If the RTL ID is used, you will have to add the two diodes and capacitor shown in Fig. 5, and bypass IC4d, shown in Fig. 3. This is because IC4d is used to invert the keying output from the TTL ID, while no such inversion is needed with the RTL ID. To disable IC4d, simply clip off pins 11, 12, and 13 of the socket which holds IC4, and run a jumper between pins 11 and 12.

All the parts in Figs. 3, 4 and 5 fit on one printed circuit board, shown in Fig. 6, which is roughly 7 x 7 in. The TTL ID referred to previously is about 3 x 7 in., and the photographs show both the ID and the control. The two can be placed together on one 7 x 10 in. board as shown, or placed on separate boards.

Figure 7 shows the actual parts placement on the board. Board layouts are available from the author if you send a SASE; etched boards and parts will also be available from *Circuit Specialists, Box 3047, Scottsdale AZ 85257.*

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A "clock" oscillator operates in bursts of 45.5 cps rate, toggling a binary counter connected to a decoder which gives accurately timed pulses 22 milliseconds long, each one the length of one RTTY "bit." The sensing contacts in the reader are either closed or open depending on the punched holes on the tape, so, if the outputs of the decoder are connected to the sensing contacts, a serial output is obtained. Diodes are added to form an "AND" gate to prevent outputs from the decoder from shorting together. The serial output then is connected to a keying transistor which may be used to operate a keying relay or key direct.

When all five bits are formed, the sequence reaches pin 7 of the decoder. The positive going edge of the pulse trips a monostable multivibrator which resets the counter to zero, shuts off the oscillator, and turns on the tape advance transistor, advancing the tape one notch. When the monostable pulse ends, the output of the NOR gate immediately goes positive starting oscillation for seven more cycles. The adjustment of the pulse length of the monostable determines the length of time the stop pulse dwells at pin 10 of the decimal decoder. For 60 wpm, this would be 31 milliseconds. Later an easy method will be given to permit setting pulse widths without a scope. Note that the monostable pulse width and the actual stop pulse width differ slightly, so if you are checking pulses, the correct place to check is at the zero (pin 10) output of the decoder.

Gates have been wired to the stop-run switch so that the device will complete the character in the gate of the TD before stopping. Normally the external control jack is unused, a positive voltage of from 1.5 to 3.0 volts on this jack will start the TD.

The tape recorder has a large tape advance solenoid. Accordingly, it is pulsed with a high current for reliable operation. As mentioned above, the monostable pulse is actually about 20 milliseconds when the

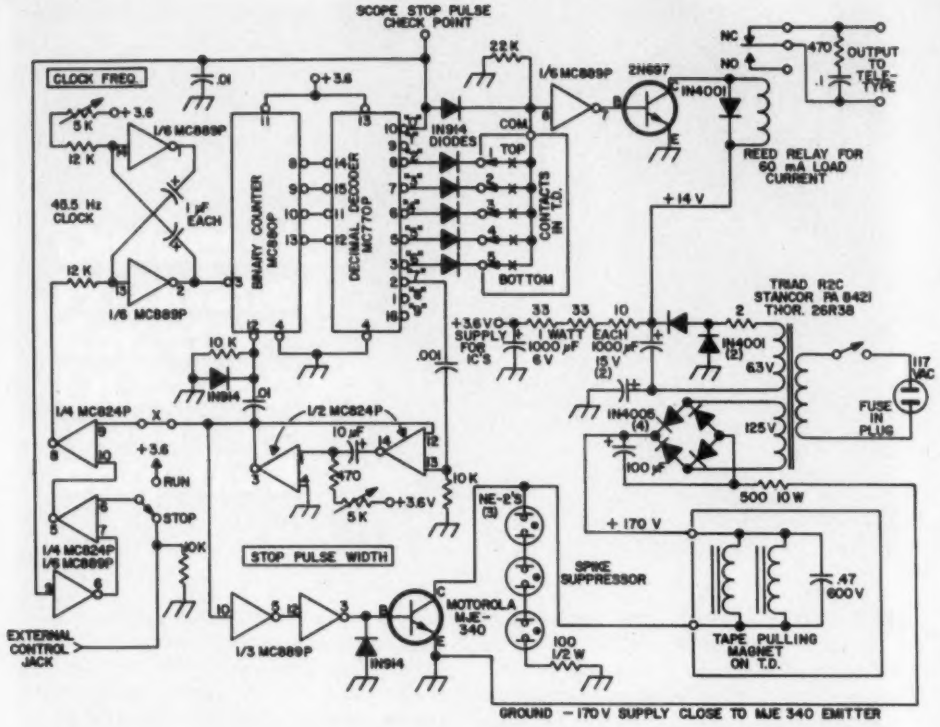


Fig. 1. Digital TD.

stop pulse is set at 31 milliseconds. The current through the magnet measures 200 mA peak but the duty cycle is so short that the average current is only about 25 mA. This permitted the use of a very small power transformer in the prototype, but other alternate members for substitutes are given. The solenoid advance transistor should not get hot in normal operation if you use the suggested types MJE 340 or HEP244. A MJE340 could also be used instead of the 2N697 for direct loop keying.

NE-2 spike suppressors have been used across the tape advance transistor to hold the transients down below the rating of the transistor. Other methods have been tried including the use of zener diodes and ordinary OB2 regulator tubes. The NE-2's do the job, are small, and cost 10¢ each. The tape advance solenoid would not operate at all when a silicon diode was connected across the coil as is usually done with relays to suppress transients.

A very simple power supply is used and was found adequate in the two models constructed. It would be advisable to check the power supply voltage to the IC's and adjust the value of the series resistors until it is approximately 3.6V. (Notes on the K4EEU TD, RTTY Journal, July-August 1972.)

When the tape recorder is received, it is necessary to strip off all the parts on the side near the Blue Ribbon connector with the exception of the pulling magnet detent. The large Advance solenoid and the linkage to the gate is removed and the gate is secured with a collar-setscrew so it cannot slide back and forth. The parts may then be mounted in the clear space. While it is possible to get all the electronics in the TD, it takes a little planning. You might want to mount the TD

on a small chassis and use this to mount the electronics, with the magnet supply in the head. An etched circuit board about 3" x 6" will hold all the integrated circuits and there is not too much wiring to do even if you want to hand wire the unit with small wire.

Two adjustments have to be made when the distributor is finished. The clock has to be set at 45.5 cps and the stop pulse width has to be adjusted. It should be pointed out that, due to the wide tolerances in electrolytic capacitors, it is possible that the clock will not adjust to 45.5 cps within the range of the pot. If this happens, merely change the value of the 12K resistor in series with the pot.

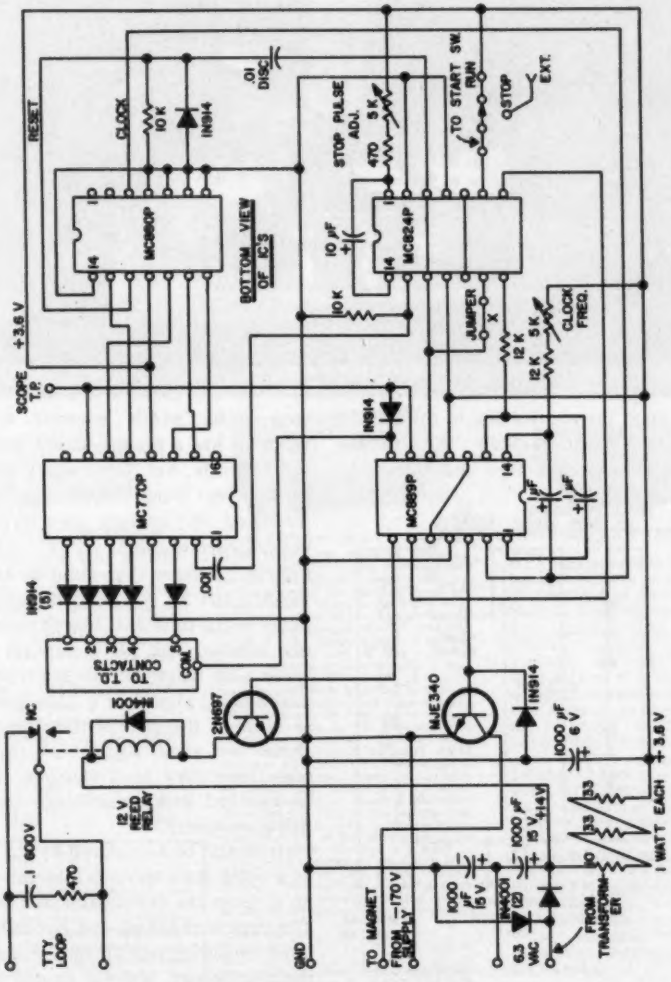
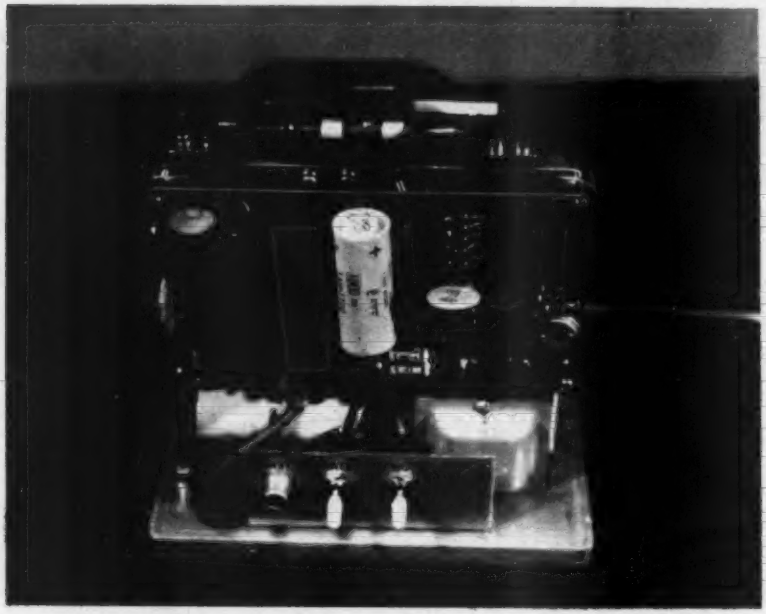


Fig. 2. Layout pattern of the Digital TD for printed circuit design.



First, open the control line to the MC824 gate at the point marked "X" on the schematic. Then run a tape and adjust the stop pulse width trimmer so that the solenoid has a snappy action and pulls tape satisfactorily, but don't worry about how it is printing. Now, adjust the clock so a measured 39" of tape goes through in one minute corresponding to 389 operations per minute. Restore the jumper at "X" and measure off 37" of tape and adjust the stop pulse width until this length runs through in one minute. The TD is now set at machine speed, 60 wpm. If the teletype printer is misprinting, check for a 22 millisecond pulse at each of the tape sensing fingers. If OK, check for good contact at the fingers – sometimes they need cleaning. The TD can be checked with an ordinary oscilloscope if this is necessary.

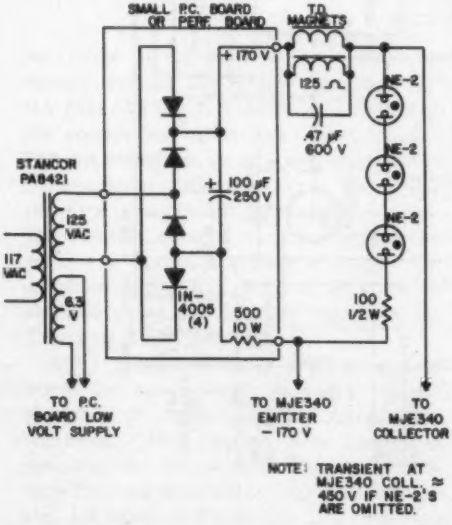


Fig. 3. Digital TD magnet supply board.

It should be recognized by the reader that as a solid state device, this unit might pick up rf from the transmitter and malfunction. The cure is shielding and bypassing external lines. Shielding was all that was necessary in the prototypes. W6FFC should be credited with the suggestion for measuring pulse widths and W4IGX made the pictures.

. . .K4EEU

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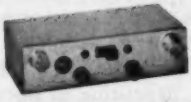

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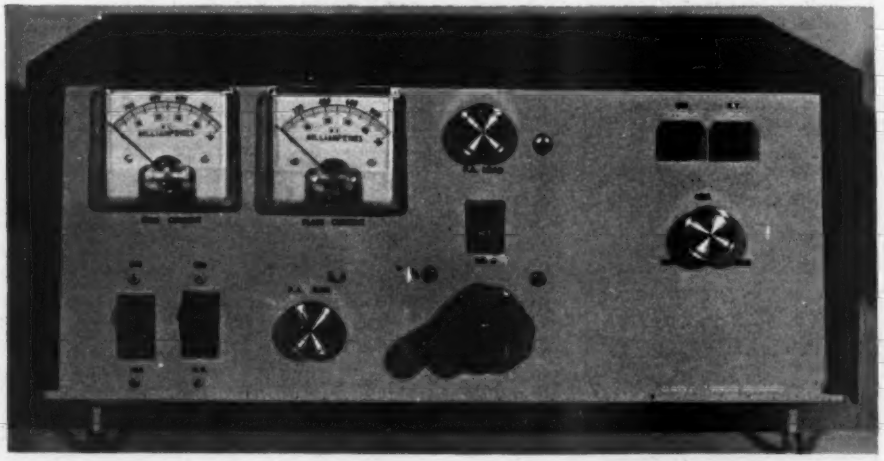
THE AMPLE AMPLIFIER

A Spunky Power Amplifier in a Compact Package for the Small Budget.

A few years ago I had the nagging urge to build another linear amplifier. I had been through the 811A phase and wanted something that would compare with commercial offerings. Still, I didn't want to stand the expense of special transformers, vacuum capacitors or bandswitching tank coils. My goal was a medium power amplifier that didn't look like it was built by the village blacksmith. It had to be simple. No space-consuming regulated screen supplies. And it had to be compact; compatible with a modern transceiver. It also had to be cheap. My XYL, like many, tolerates my hobby providing it doesn't cost anything.

The amplifier described below was conceived on a circuit found in Editors and Engineers, Ltd. Handbook. The original creation, designed by W6SAI, was presented as a versatile amplifier that could be built around 811's, 813's, 4CX250's, a 4-1000, or several other tubes, depending on the build-



This package produces over 1200W P.E.P. in a unique circuit featuring cathode driven 4CX250 B's. It is complete with power supply.

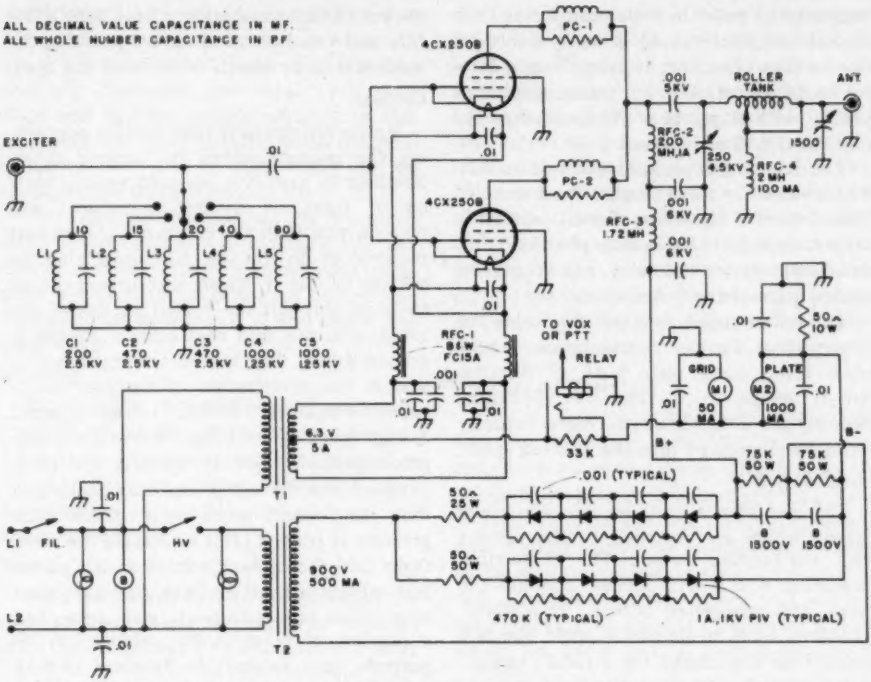


Fig. 1. L-1, L-2: (0.15 μH) 4 turns No. 16 enamel on National XR-50 ½ in. diameter. Slug removed from both coils. L3, L-4: (0.31 μH) 6 turns No. 14 enamel on National XR-50 form. Slug removed from L-3. L-5: 1.3 μH) 13 turns No. 18 enamel on National XR-50 form. PC-1, PC-2: 3 turns No. 16 enamel wound on 50 ohm, 2W carbon resistor.

er's preference. My choice of the 4CX250's was dictated by the fact that I wanted my amplifier compact. Also I had the bottles. The finished result has pleased me very much. It has proven to be very stable and free of parasitics. It has no "touchiness" characteristic of home brew projects. And it is not critical as to layout. My components are virtually shoe-horned in and yet there was no necessity to neutralize or relocate circuits. It has produced eyeball compliments and on-the-air results.

This is not being presented to the reader as an engineering triumph, however, but as a challenge to his imagination and enterprise. You may surprise yourself as I did!

The Circuit

The ceramic tetrodes are operated as low mμ triodes. The control grids are tied to the cathodes. With conventional Class-B grounded grid operation the grids would be promptly destroyed. In this mode, however, grid current is nil, idling current is low (about 35 ma), and feedthrough power is high. It takes about 150-200 watts of drive, but I consider this an asset, since there is no necessity to swamp the input. Either one of my transceivers drives it adequately.

A tuned-cathode input circuit is used to present a better load to the exciter. Rf isolation in the filament circuit is afforded by a home-brew filament choke. Bias is developed through a 33K cathode resistor. When in the standby mode, plate current is virtually zero. During operation a relay shunts out this resistor. When not driven the tubes will idle as stated above.

The tank circuit consists of a roller coil and tuning capacitor from a BC-375 tuning unit. A Barker and Williamson bandswitching inductor could be substituted, but I

happened to have the roller coil handy. The loading condenser could be aptly dubbed a free-loading capacitor. It came from a derelict broadcast set. A 500 pF mica capacitor in parallel with it provides plenty of capacity even for the 80 meter band.

The coupling capacitor, specified as .001 5 kv is solved by using parallel "beer barrels" from discarded television chassis. A parasitic suppressor is included in each plate lead, but no adjustment was necessary, and I found no tendency toward self-oscillation.

The power supply is solid state using the conventional doubler configuration. I hesitated about using only 4 μF of filtering. but it seems to do the job. By using electrolytics I think much more capacity could be engineered into the allotted space.

Construction

The amplifier is built on two aluminum chassis which are fastened to the cabinet with self-tapping screws. The rf section, measuring 4 x 6 x 2 inches, contains the tubes and associated wiring. The shield enclosure, built on aluminum angle, stands 4 inches over the chassis for a total "height" of 6 inches. Actually the rf assembly lays on its side and fastens to the back of the cabinet with a cork gasket as an air seal. A centrifugal blower delivers air through a hole in the cabinet into the bottom of the pressurized rf chassis.

The power supply is mounted on a 5 x 9 x 1½ inch chassis. Silicon rectifiers, surge resistors, and associated components fit easily underneath. The oil capacitors mount topside with the power transformer sitting directly behind them. Two angle brackets secure it to the rear of the cabinet. Electrical connection between the transformer and the power chassis is made through a husky four prong plug. With no room left for the bleeders, they are secured *outboard* on the supply chassis.

All other components; tuning capacitor, coil, loading condenser, filament transformer and relay are bolted or screwed directly to the steel cabinet.

The layout of components, as you can see, is non-critical, but it takes a little planning to come out with space for everything. Obviously there is no room for the blower inside. Except for a hand drill, a few files and two borrowed socket punches, the work was done mostly with sweat and tears.

Cooling

Entire articles have been written concerning the proper cooling of ceramic tubes. Needless to say, it is *not* sufficient to blow air *at* them. A modest investment will provide you with the chimney type sockets required to do the job. By pressurizing the bottom of the rf chassis and forcing the air to leave through the finned anodes of the tubes, you will find that correct cooling is accomplished. The builder is urged not to sample the temperature of external anode tubes because of the lethal voltage present! A high speed squirrel cage blower is strongly recommended. "Silent" blowers are more compact and less noisy, but I can assure you that they won't work well against back pressure (I tried it.) Hot air leaving the tubes flows into the cabinet, but since this particular cabinet is itself air tight, provision must be made to release th pent-up air. I punched a number of holes in the cabinet for this purpose (just behind the filament choke). Additional holes located in the cabinet bottom near the bleeder resistors serve to carry excess heat away from these components in the process.

Power Supply and Filaments

The power supply is built around a husky 900 volt transformer which was appropriated from an old projection television set. Silicon rectifiers in a voltage doubler develop 2,400 volts dc. The bleeders are mounted over a series of holes where air, exiting from the solid cabinet, carries the excess heat away. Besides offering a margin of safety and equalizing the voltage drop across the series filter capacitors, the bleeders provide some degree of voltage regulation.

4CX250's require 6.0 volts on the filaments. Excessive voltage will seriously impair tube life. You have the choice of inserting a series dropping resistor in the primary winding of the filament transformer or doing what I did. I patiently unwound and rewound the secondary winding of a 6.3 volt filament transformer. If you decide to do this, be sure to get the center tap electrically centered, or you will have a

transformer that overheats. It is really not as difficult as it sounds and certainly worth the try if you have an old filament transformer available. Naturally you must keep your plate and filament supply separate so that the tubes can be preheated prior to application of B+. A time delay relay can be employed for this purpose.

The filament choke in my rig is a home made affair wound on a ferrite rod ala Lafayette radio. A search through old magazines will provide the details. A commercial choke can be substituted if you throw old issues away!

Metering

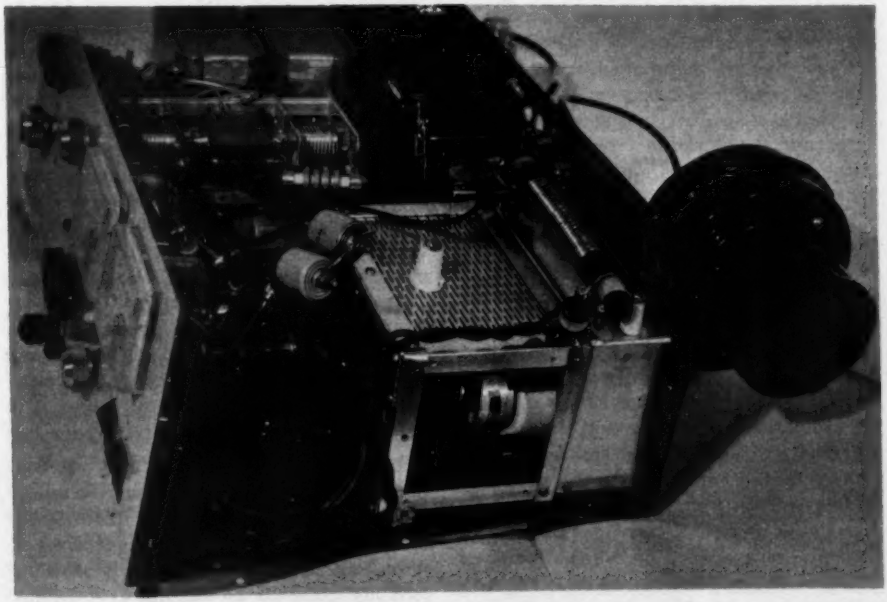
Plate current and grid current are monitored in the negative return leads as a safety precaution. This places B- above ground. a 50 ohm 10 watt resistor across the plate meter serves as a safety device should the meter coil open.

Tuned-Cathode Tank Circuit

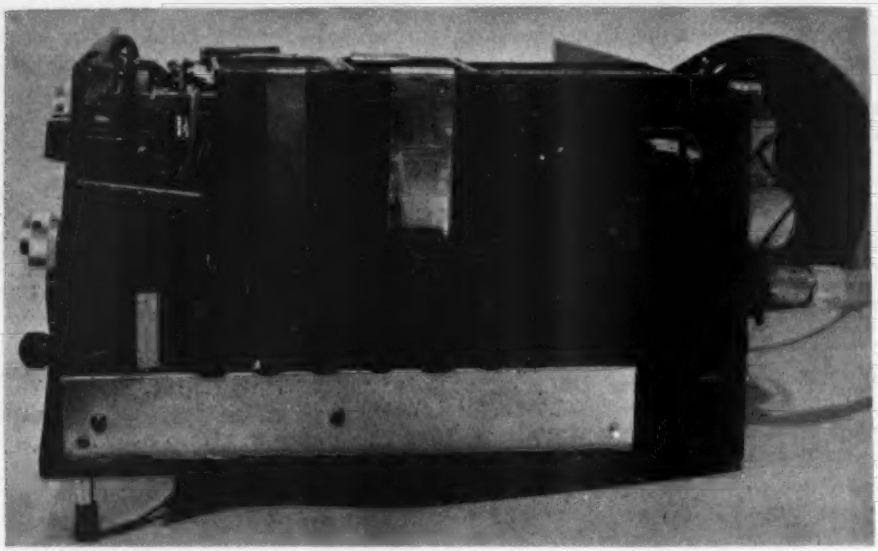
Separate tuned circuits are provided for each amateur band. My amplifier contains only the 80-40 and 20 combination. I built the linear to use with a 3 band transceiver which has since been replaced with an all band unit. I personally do not feel the need for higher power on the 10 and 15 meter bands, but coil values are provided for those who care. Coils are wound on slug tuned coil forms. The slugs are removed for 10-15 and 20 meters. A mica capacitor is soldered in parallel with each coil. Each coil and capacitor should be resonated, if possible with a grid-dip meter. After all coils are mounted around the bandswitch the box is shielded (a mini-box will do) and secured to the amplifier front panel.

Tuning and Operating

The amplifier should be carefully checked for any sign of instability before any attempt is made to drive it. This is done by connecting a dummy load and applying plate voltage, running the coil, tuning capacitor and loading capacitor through their range while monitoring grid and plate current. If you are as fortunate as I was, you will see zero grid current, and the plate meter will sit on 35 ma like a rock. If a weak parasitic is



This view shows the rf section and blower. The filament choke is mounted at the rear with the filament transformer at the front. The tuning capacitor is partially visible behind the transformer. The holes behind the filament choke release heated air from the cabinet.



The power and bleeder resistors occupy most of the right side of the amplifier. The small minibox is the tuned cathode assembly. The roller coil and loading condenser is sandwiched in the middle, not visible, the latter piggy-back on the coil. The husky power transformer is seen at the right.

found, it may help to compress the coils on the parasitic suppressors in the plate leads. If the amplifier is determined to be stable under all conditions it may be connected to the exciter. A realtive output meter in the output of the linear is a *must*. Tuning is accomplished much as with modern transceivers; ie: resonance should be found *quickly*. With a little practice all tuning and loading can be accomplished in a matter of several seconds. With the output meter in the line it is a simple matter to tune for *maximum output*. When properly tuned the grid current is very low; from plus two or three ma to minus one or two ma. Grid current should never be allowed to go beyond 10 milliamperes and the ideal condition is zero. This can be controlled with antenna loading and drive. Excessive antenna loading will produce negative grid current, excessive excitation creates high positive grid current. Under normal operating conditions grid current will flicker slightly (1-2 ma) with voice peaks. Plate current will peak approximately 1/3 to 1/2 of dc tune condition. Typically, plate current will talk up 100-150 ma depending on voice characteristics, etc. Shouting into the mike to produce higher readings will cause flat topping, distortion and citations. After a little experimentation the settings for tuning and loading capacitor and roller coil can be logged and will speed up the tuning process. Actually the amplifier is quite rugged and is easily operated with some experience.

It should be noted that the amplifier presents a different load to the exciter than does the antenna. This means that some retuning of the transceiver is required to go from *barefoot* to *shoes* operation. This is not inconvenient, however, and takes only seconds.

Conclusion

In closing, I would like to thank Editors and Engineers, Ltd. for allowing the use of this excellent circuit from the Radio Handbook. Though I've built many pieces of equipment in 15 years of hamming, this has certainly qualified as the finest of all my building experiences.

...K9PYY

Don Miller W9NTP
Box 95
Waldron IN 46182

Ralph Taggart WB8DQT
4515 Oakwood
Okemos MI 48864

POPULAR SSTV CIRCUITS PART II

This is the second part of a two part article describing circuits and their functions in SSTV. Part I covered the use of operational amplifiers, timing and gating circuits, phase lock loops and sweep generation. This section will continue the discussion with descriptions of slow scan sweep drivers, subcarrier generators, limiters, discriminators and active filters. A regulated power supply that is suitable for the above circuitry is also presented.

Sweep Drivers

It was recognized very early in the development of slow scan television that magnetically deflected P7 radar tubes would produce brighter better focused pictures than were possible with electrostatic tubes. K9QYI and W9KVK rewound radar deflection yokes and used large tubes such as 6L6's and 6Y6's to deflect the beam. All of these attempts were successful but the difficulty of rewinding the yoke and the requirement of heavy dc power supplies kept electrostatically deflected monitors popular.

Today all of this complication has been changed with the introduction of complimentary transistors and economically priced operational amplifiers. A very fine sweep driver can be built that can drive ordinary TV yokes without modification. Surplus P7, 5FP7, and 7BP7 tubes can be driven by these sweep drivers. They produce excellent linear slow scan pictures. Consider the circuit shown in Fig. 2-34.

The initial sweep in this circuit is produced by charging capacitor C positively through size control R2 from a positive supply voltage. This RC time constant is made long compared to the pulse repetition period of the sync pulses applied to the base of transistor Q1. When the positive sync pulse turns on transistor Q1, the capacitor voltage falls to near zero voltage. IC1 is an operational amplifier with its non-inverting input connected to the capacitor positive going ramp. The output of the op-amp drives the complimentary pair transistors to produce an effective push-pull ramp at the emitter output. This emitter follower output is very low impedance and can drive TV yokes directly. In order to control gain and stability a negative feedback voltage is developed across a small resistor, R4, connected in series with the yoke. The overall gain is therefore set by the ratio of the 100K feedback resistor divided by the 33K input resistor.

As described in the discussion of the op-amp, offset or centering can be done easily by feeding current into the inverting input. The 741 op-amp is sometimes limited

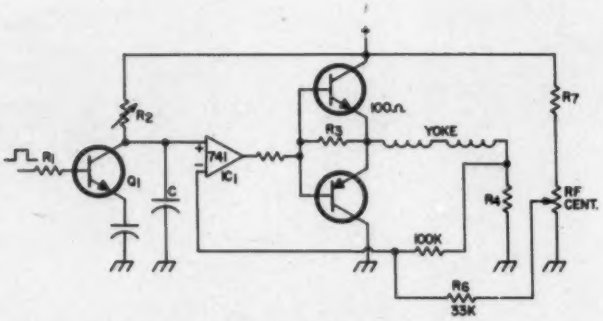


Fig. 2-34. Magnetic sweep driver.

in this application by having a slower slew rate than the compensated 709. The result of having this limitation is the appearance of a small demarcation line in the center of the slow scan picture at the time that the transistors switch across the base emitter potential. Some designers put a small resistor, R3, across the base emitter junction to smooth out the discontinuity by feeding op-amp current directly to the yoke. This works very well.

Subcarrier Generators

The most popular subcarrier generator is the voltage controlled multivibrator. Most SSTV systems use this type of subcarrier generator. The free running multivibrator is shown in Fig. 2-35.

The base of each transistor is connected to the opposite transistor collector by a C1 or C2 capacitor. Since the ac coupling does not permit either base to lock up into a stable state, the transistors oscillate back and forth at a rate determined by the coupling capacitors, base resistors and the voltage applied to the end of the base resistors. As an example, if Q1 goes from a non-conducting state to a conducting state, the base of Q2 is negatively driven because the capacitor C1 cannot change its voltage instantly and, therefore, Q2 is turned off. C1 now charges positively from approximately −10V toward the voltage level EB connected to the base resistor. The voltage builds up until the base of Q2 conducts causing opposite transistor Q1 to turn off by similar action The sketch of the voltage changes is shown in Fig. 2-36.

It can be seen that the larger the time constant T1, the longer the recycling time. It is also noticed that the potential toward which the capacitor charges determines the frequency because it changes the time when the charging curve crosses the base emitter conducting voltage. Higher EB voltage will drive the frequency higher. The multivibrator can be used as a voltage controlled oscillator. If EB is made to vary at an audio rate around some dc steady voltage, the VCO will have an FM output. Care should be taken to make sure that the potentials and RC time constants are adjusted properly so that the cycling takes place over a relatively linear region of the TC period otherwise the VCO output frequency will not vary linearly with input voltage. All voltages should be large relative to the base emitter voltage of

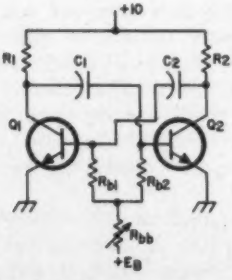


Fig. 2-35. Basic multivibrator.

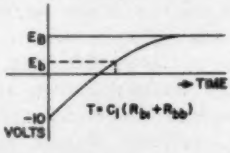


Fig. 2-36. Voltage changes in the basic multivibrator circuit.

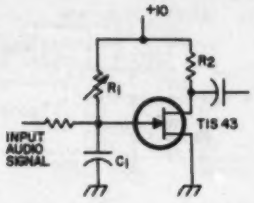


Fig. 2-37. Unijunction VCO oscillator.

the transistors. Some experimenters have used constant current sources instead of base resistors to give linear charging of the capacitors. This results in a very linear VCO.

Another popular type of VCO is the unijunction oscillator. The basic oscillator is shown in Fig. 2-37.

The VCO utilizes the negative resistance of the unijunction transistor to cause the capacitor C1 to charge and discharge at a rate determined by the product of R1 and C1. When capacitor C1 charges to a given level, the unijunction transistor conducts and discharges the capacitor C1. If audio is applied to the capacitor C1, the net charge can be changed at an audio rate and, therefore, cause the unijunction transistor to vary in its output frequency. In this way an FM SSTV signal is formed. The resistor R2 is for temperature compensation. Usually the unijunction oscillator is designed to operate at twice the desired frequency in order to drive a JK flip-flop to give a square wave output for better filtering. The output voltage of the unijunction oscillator is a very narrow pulse.

Last and the best is the phase lock loop VCO. We have used the Signetics 565 in several applications. It is extremely versatile and permits a variety of signal processing functions. The SE 565 is an integrated circuit consisting of a VCO phase detector and filter. The VCO can be used directly by adding the correct capacitor on the VCO terminals. The hookup and calculated values are shown in Fig. 2-38. The new Signetics SE/NE-566 IC VCO may also be used.

The linearity is extremely good and is the best choice for the slow scan experimenter since the other functions of the PLL can be utilized in a clever manner to produce a very sophisticated slow scan FM generator.

At last – the long awaited TEEC SSTV System !

TEEC HCV-1B SSTV Camera

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- 48 transistors, 14 IC's, 16 diodes, 7735A Vidicon.

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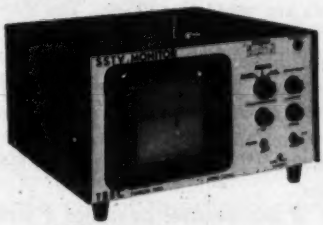

TEEC HCV-2A Monitor

Features
- 5.75" diagonal screen.
- Removable picture tube filter for added viewing flexibility.
- Tuning meter aids tuning in of SSTV signal.
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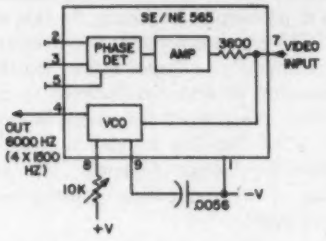

Fig. 2-38. Phase lock loop VCO.

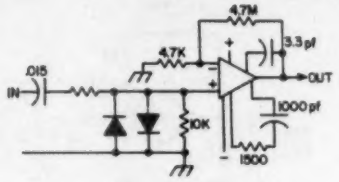

Fig. 2-40. Saturating op-amp limiter.

Limiters

Slow scanners in the past have used several kinds of limiters preceding their discriminators. In the early tube Macdonald monitor, the limiting action was through the use of grid resistors in the conducting grid audio amplifiers. Today the standard limiter utilizes the operational amplifier. The 709 is the best economical choice since it can be compensated for higher frequency response and has a higher slew rate than the internally-compensated 741.

The non-saturating operational amplifier is shown in Fig. 2-39. The limiting action comes from the back-to-back diodes across the input and output terminals. The input diodes across the inverting and non-inverting inputs are protective diodes. The non-linear feedback from the feedback diodes result in a logarithmic relationship between the input voltage and the output. The output voltage is approximately the drop of the diodes. If greater output is needed, the output can be subdivided to supply the two feedback diodes.

It is also possible to utilize a saturating limiter (Fig. 2-40). Again an operational amplifier is used in another configuration. This time the amplifier output is driven to the supply voltage limits. If the supply voltage has a ripple, there is danger that the output will also show these ripples. The gain is very high and care must be taken to make sure that the output is square wave.

The slew rate and frequency response of the high gain op-amps make both of these limiters poor at frequencies higher than audio frequencies. At slow scan frequencies they both perform reasonably well. Again diodes are used to protect the input of the op-amp.

Discriminators

Slow scan television uses an FM subcarrier to give noise immunity on high frequency (HF) radio channels. The three important standard frequencies are:

1. 1200 Hz – sync
2. 1500 Hz – black
3. 2300 Hz - white

In order to utilize the transmitted slow scan information, it is necessary to FM detect the transmitted signal to produce an amplitude modulated signal to synchronize the sweep circuits and to intensity modulate the Z axis of the monitor picture tube.

The earliest slope detector described in the literature of March, 1964 *QST* was the one-sided slope detector with a separate resonant 1200 Hz tuned circuit for sync recovery. The success of this monitor speaks well for the circuit. The frequency versus amplitude response curve was approximately linear. Figure 2-41 shows the response of

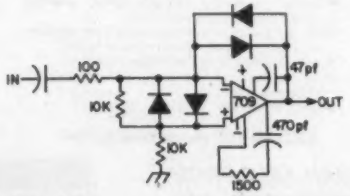

Fig. 2-39. Non-saturating op-amp limiter.

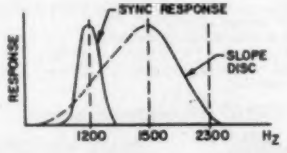

Fig. 2-41. Negative slope discriminator.

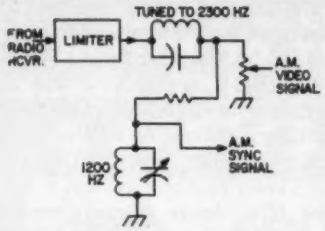

Fig. 2-42. One-sided negative slope discriminator and sync receovery circuit.

both the sync recovery circuit and of the slope discriminator. The block diagram of the circuit is shown in Fig. 2-42.

It is interesting to note that in the absence of signal that the response approaches 2300 Hz and the Z axis modulation is maximum beam illumination. This causes noise pulses to appear as white streaks on the viewed image.

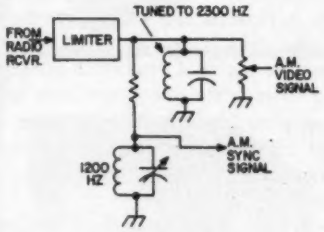

Fig. 2-43. One-sided positive slope discriminator.

This effect has been corrected by some builders by tuning the slope discriminator to have a positive slope instead of a negative slope. The immediate effect of doing this is to reverse the video from black to white and vice versa. This can be corrected by adding a stage of video phase reversal. This is extremely easy to do if operational integrated circuit amplifiers are used. The response of the positive slope discriminator is shown in Fig. 2-43. The block diagram is shown in

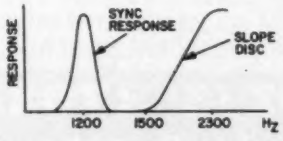

Fig. 2-44. Positive slope discriminator.

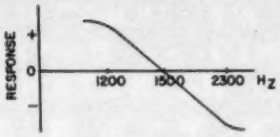

Fig. 2-45. Double-sided discriminator.

Fig. 2-44. In the positive slope discriminator noise pulses have a tendency to drive the response to 1500 Hz or black output to the monitor screen.

A better solution to video recovery is the use of two tuned circuits to create a double sided discriminator linear response curve. This response can extend to the 1200 Hz sync frequency or just include the video spectrum. The entire spectrum is covered by the two sided response curve shown in Fig. 2-45. The block diagram is shown in Fig. 2-46. This characteristic can be created by the use of two tuned circuits tuned to 1200 Hz and 2300 Hz respectively. The method of sync extraction used in such circuits can be either (1) another narrow band tuned circuit or active band pass filter tuned to 1200 Hz, or (2) use of a phase lock loop or integrator to filter the sync pulses recovered from the discriminator response.

It should also be mentioned that there are new integrated circuit phase lock loop circuits such as the Signetics 565 on the market which seem to offer some possibility of direct detection of the FM signal. The bandwidth of these circuits is marginal at the subcarrier frequency however.

Another type of discriminator called the pulse counting discriminator can be used to detect the FM signal and requires no tuned circuits of any kind. This circuit works on the principle that a monostable multivibra-

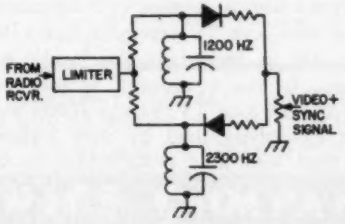

Fig. 2-46. Double-sided discriminator circuit.

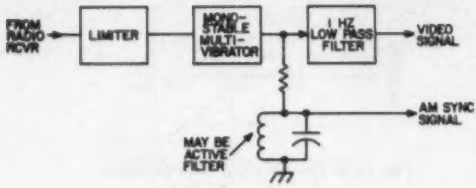

Fig. 2-47. Pulse counting discriminator.

tor can be triggered by the zero crossings of the amplitude limited FM signal. This monostable oscillator has a recovery time of less than one half of the period of the highest frequency detected. The net result is a series of equal width pulses occurring at every zero crossing of the FM signal. The output voltage of this monostable oscillator has an average value equal to the desired vido slow scan signal. In order to recover only this low frequency signal, it is necessary to filter the square wave output of the multivibrator by means of a high order active band pass filter. The block diagram is shown in Fig. 2-47.

In order to ease the requirements of the filter, the monostable oscillator is connected to produce square waves of twice the incoming FM signals that vary between 1500 and 2300 Hz and are in reality 3000 and 4600 Hz in the output of the monostable. Since the slow scan video only extends to 900 Hz, filtering is made relatively easy.

Again as in other types of discriminators, the sync pulses at 1200 Hz can be recovered in any number of ways. An active bandpass filter centered at 1200 Hz with manual tuning of the center frequency seems attractive and utilizes similar circuitry as used in the multiple pole active low pass filter used on the pulse counting discriminator.

Active Filters for Slow Scan TV

Anyone who is engaged in the construction of slow scan TV gear soon learns that filters play an important part in the performance of the equipment. In the early years of slow scan TV, passive filters were almost exclusively used by slow scanners since they were able to capitalize on the filter design experiences of RTTY hams. The availability of 88 mH and 44 mH chokes made it possible to use the RTTY designs with slight modifications.

The design of practical filters is difficult and the filters are not very rewarding in performance because of passive loading effects. Today with active filter design made possible by the use of low-priced operational amplifiers, anyone can be a filter designer and achieve excellent results. The biggest problem is knowing where to start.

Active filter design is made easy and excellent performance is achieved because the elements are isolated by op-amps. These op-amps have extremely high input impedance and nearly zero output impedance when hooked up in the voltage follower configuration. Before discussing the actual design of filters, let's examine the filter performance specification needed in a slow scan monitor to recover the sync pulses and video information.

The sync frequency is a burst of 1200 Hz which lasts for 5 ms and 30 ms respectively for the horizontal and vertical synchronization. The length of the pulse gives the designer the required bandwidth of the filter needed to separate the pulses from the FM video information which lies between 1500 Hz and 2300 Hz. A good approximation of the bandwidth needed for a 1200 Hz – 5 ms burst is shown in Fig. 2-48.

τ is 5 ms or 0.005 seconds. If it is desired to pass the major part of this pulse spectrum, the filter BW should equal $2/\tau$ = 2/0.005 = 400 Hz. This means that the energy of the major frequency lobe of the pulse will be passed by the filter. The other minor lobes will be rejected. If the filter is made wider, video signals will get through the filter and if the filter is made narrower the rise time of the pulse will be increased.

Let us now design an active bandpass for sync recovery filter. This will be a low pass filter centered around 1200 Hz. It will have a bandwidth of 400 Hz. It will use no coils and will provide for adjustment of the center frequency for SSB carrier reinsertion error.

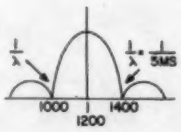

Fig. 2-48. Bandwidth of horizontal sync pulses.

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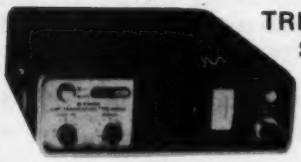

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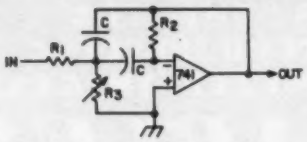

Fig. 2-49. Active bandpass filter.

The configuration that will be used is shown in Fig. 2-49. It is called a multiplier feedback active bandpass filter. We can now choose arbitrarily the gain and the value of the capacitors since resistors are cheaper than capacitors, and can be purchased in wider selected sizes.

A = Gain = 10
C = 0.01 microfarads
B = Bandwidth = 400 Hz
F = Center frequency = 1200 Hz

$$R_1 = \frac{1}{2\pi BAC} = \frac{1}{6.28 \times 400 \times 10 \times 0.01 \times 10^{-6}} = 3980\Omega$$

$$R_2 = \frac{1}{\pi BC} = \frac{1}{3.14 \times 400 \times 0.01 \times 10^{-6}} = 79,600\Omega$$

$$R_3 = \frac{1}{2\pi C\left(2F^2 - BA\right)} = \frac{1}{6.28 \times 0.01 \times 10^{-6}\left(\frac{2 \times 1200^2}{400}\right) - 400 \times 10} = 5000\Omega$$

The complete filter is shown in Fig. 2-50. R3 can be made adjustable to allow for a slightly different center frequency. In many ways this is an easier route than using a parallel tuned 88 mH inductance for sync recovery.

Now let's design a vertical pulse filter. The bandwidth needed is again twice the inverse of the pulse width time.

Bandwidth $B = 2\left(\frac{1}{\tau}\right) = \frac{2}{30\text{ ms}} = \frac{200}{0.03} = 66.6$ Hz. The values and parameters are:

C = 0.06 μF
A = 10
B = 66.6 Hz
F = 1200 Hz

$$R_1 = \frac{10^6}{6.28 \times 66 \times 10 \times .06} = \frac{10^6}{251} = 3980\Omega$$

$$R_2 = \frac{10^6}{3.14 \times 66.6 \times .06 \times 10^{-6}} = \frac{10^6}{12.53} = 79600\Omega$$

$$R_3 = \frac{10^6}{6.28 \times .05\left(2\left[\frac{1200 \times 1200}{66.6}\right] - 66.6 \times 10\right)} = \frac{10^6}{.314(43200 - 666)}$$

$$= \frac{10^6}{.314(41,534)} = \frac{10^6}{13,300} = 750\Omega$$

The circuit for vertical sync is shown in Fig. 2-51.

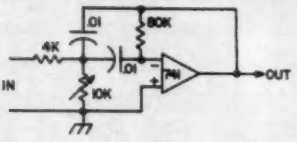

Fig. 2-50. Active BP filter for 1200 Hz.

Most slow scan monitors rectify the 1200 Hz sync burst in order to recover the video sync pulse. It is better to use full wave rectification because the carrier (1200 Hz) is converted to 2400 Hz and consequently it is easier to filter the desired separated pulse. As before the bandwidth of the sync pulse (video pulse) is related to $1/\tau$. In this case

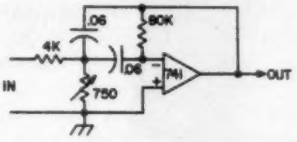

Fig. 2-51. Vertical sync recovery circuit.

there is a frequency fold over at zero frequency because negative frequencies do not exist in real time. The bandwidth needed to recover the pulse is $1/\tau$=1/5ms=200 Hz for the horizontal pulse and 1/300ms=33 Hz for the vertical pulse.

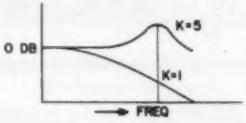

Fig. 2-52. Low pass filter response.

This filtering job is relatively easy since the frequencies to be separated are many octaves apart (i.e., 200-2400 Hz is 200 - 400 - 800 - 1600 - 3200 or about 3½ octaves apart. A three section low pass filter will provide about 20 dB or a 10/1 reduction of the 2400 cycle component. More sections

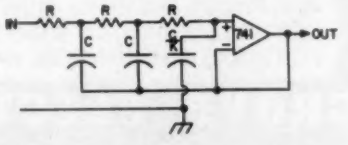

Fig. 2-53. Low pass sync pulse filter.

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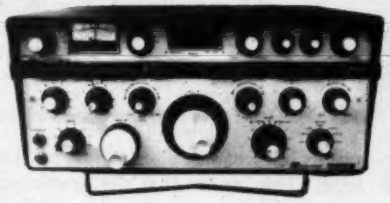

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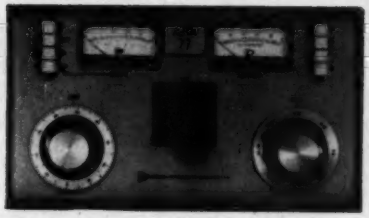

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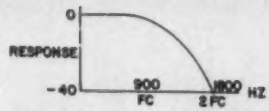


Fig. 2-54. Seventh order Butterworth filter response.

can be added if more rejection is needed. The circuit shown is interesting in that it has provision for providing a rising response near cutoff on the bandwidth edge as shown in Fig. 2-52.

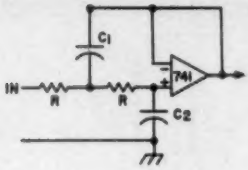
This rising response can act to decrease the rise time of the pulse, but if it is used to extreme, it can cause ringing of the recovered pulse. The circuit is shown in Fig. 2-53 which provides about 18 dB/octave attenuation after cutoff.

$$\text{LET } R = 100\text{ K}$$
$$BW = 200$$
$$R = 1/\omega c \text{ or } C = 1/2\pi fR =$$
$$1/6.28 \times 200 \times 10^5 = 0.0079$$
$$= 800\text{ pF}$$

K probably should be chosen by experiment to give best rise time without ringing. The component values for both vertical and horizontal sync pulse recovery is as follows:

HORIZONTAL	VERTICAL
R = 100K	R = 100K
C = 0.008 μF	C = 0.048 μF
$\frac{C = 0.0016\ \mu F}{K}$	$\frac{C = 0.009\ \mu F}{K}$

There is one additional filter that is needed in a slow scan monitor that must be designed very well. The SS video information is about 900 Hz wide. This must be recovered from the FM subcarrier which varies from 1500 – 2300 Hz. Full wave AM detection is done after FM detection and



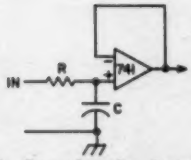


Fig. 2-55. Second order Butterworth (full sections)

results in frequency doubling of the spectrum. This means that the unchanged 0 – 900 Hz slow scan video signal for display must be separated from the 2400 Hz sync and 3000 Hz black signal. These two signals are less than two octaves apart from the 900 Hz video so a fairly sophisticated filter must be used.

For our purposes a Butterworth design will be chosen which has a flat passband response. Other designs permit a variation in the passband response in order to achieve greater rejection of the frequencies near cutoff or a better phase response.

We would like to reject the carrier components, at least 40 dB between 1 kHz and 3 kHz. Figure 2-54 shows the response of a seventh order filter. This Butterworth filter attenuates about 40 dB/octave so this design can be used.

The configuration for each section (3 and ½ sections needed) is shown in Fig. 2-55.

For convenience design constants are shown for orders of Butterworth filters up to 7th.

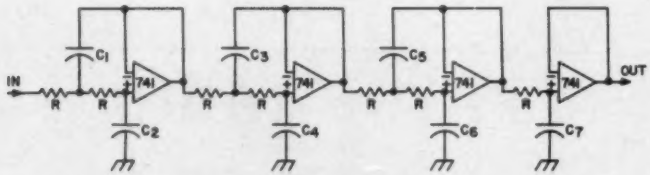


Fig. 2-56. Seven pole Butterworth low pass filter.

Order	K1	K2	K3	K4	K5	K6	K7
1	1						
2	1.414	.707					
3	2.0	.5	1				
4	2.61	.38	1.08	.924			
5	3.24	.31	1.24	.81	1		
6	3.86	.26	1.42	.707	1.04	.97	
7	4.50	.223	1.604	.624	1.11	.9001	1.0

The design of the filter is as follows:

Let all R's = 100K

Let BW = 1000 Hz

So $W_c = 2\pi F = 6.28 \times 1000 = 6280$

$R W_c = 6280 \times 10^5$

$RW_c = 628 \times 10^6$

		Calculated Value pF	Standard Value μF
C1 =	$\frac{K1}{RWc} = \frac{4.49}{628 \times 10^6}$ =	7150	0.0068
C2 =	$\frac{K2}{RWc} = \frac{.223}{628 \times 10^6}$ =	355	0.000360
C3 =	$\frac{K3}{RWc} = \frac{1.6}{628 \times 10^6}$ =	2550	0.0025
C4 =	$\frac{K4}{RWc} = \frac{.624}{628 \times 10^6}$ =	992	0.01
C5 =	$\frac{K5}{RWc} = \frac{1.11}{628 \times 10^6}$ =	1770	0.02
C6 =	$\frac{K6}{BWc} = \frac{.901}{628 \times 10^6}$ =	1430	0.0015
C7 =	$\frac{Wc}{BWc} = \frac{1}{628 \times 10^9}$ =	1590	0.0015

Although it will probably not be needed in the slow scan TV design, this procedure can easily be used to build high pass filters. In this case, choose the C's equal and calculate the R's with this formula: $R_1 = 1K_1W_cC$ etc. R's and C's exchange position s in all the circuits for a high pass configuration.

The complete filter design is shown in Fig. 2-56.

Power Supplies

Many slow scanners can still remember the days when the design and construction of a power supply was the simplest part of building a piece of electronic equipment. With the introduction of solid state devices and their requirements for low voltage and high current came the need for complicated regulated power supplies.

The various parts of a solid state device will interact through the common resistance of the power supply if the power supply output impedance is not low. This effect can be easily understood by studying the simplified power supply circuit shown in Fig. 2-57.

In this diagram the dc source is assumed to have zero impedance. The normal power supply resistance has been added together and called R_S. The voltage of this dc source is the output voltage of the power supply in the absence of any load.

Upon the application of load, the output voltage drops to a lower value. This new output voltage is given by:

$R_{out} = E_{oc} [R_L/R_L+R_s]$

where E_{oc}=dc source voltage (open circuit).

This drop in voltage is called voltage regulation. This equation easily shows that the only way the output voltage can be made to remain constant with load is to reduce RS to zero ohms. Normally several loads are connected to a power supply simultaneously and each separate load causes the voltage to vary. This results in coupling between circuits and usually means that solid state devices refuse to operate in the desired manner. It has been stated that it is output resistance that must be near zero ohms but in reality it is the impedance that becomes important. Loads vary in their load requirements over many frequencies so care must be taken to assure that the power supply has good regulation throughout the frequency range of the load requirements.

In order to reduce the internal impedance to near zero value, feedback is used to force the input voltage up when the output voltage tries to drop. In addition some kind of a reference voltage is used to provide the standard of regulation desired. In order to build a regulated power supply, it is necessary to drop voltage across a series regulator. This series regulator is provided with a feedback voltage from the output circuit to

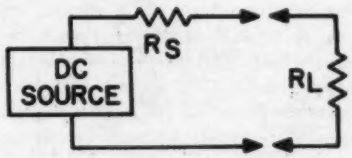


Fig. 2-57. Simplified unregulated power supply.

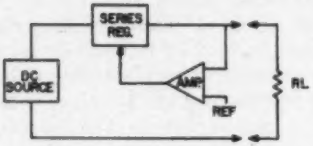


Fig. 2-58. Simplified regulated power supply.

cause the regulator to either drop or pass just the amount of voltage to compensate for the output change. This is demonstrated in the circuit shown in Fig. 2-58.

The amplifier compares the input voltage from the power supply output circuit with the reference voltage. If the output voltage is higher than the reference voltage then the series regulator is turned off to drop more voltage. If it is lower, the opposite happens. In all cases it is necessary to have the dc voltage about 50% higher than the desired output voltage in order to make the series regulator operate effectively.

This amplifier can be an operational amplifier. From the previous description of its operation, it will be remembered that it has both inverting and non-inverting inputs. These inputs can be used to advantage. Usually the reference is a zener diode that has a constant voltage drop of about six volts. This diode should be temperature stable and operate with as low dissipation as possible. Regulated power supplies should have some kind of current limiting. Most hams sooner or later short a regulated power supply and since the power supply is incapable of providing infinite current, it burns out the series regulator. One favorite way to prevent this is to put a small resistor in series with the regulator inside the feedback loop. The IR voltage developed across this resistor is used to turn off the regulator automatically. The resistor size is usually chosen so that the maximum current times the resistance value equals the base emitter drop of a silicon transistor (0.6V). This is shown in Fig. 2-59.

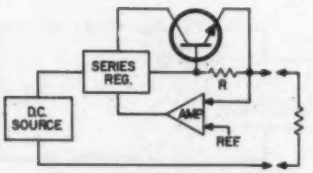


Fig. 2-59. Current limited regulated power supply.

Integrated circuits today require quite a large number of dc voltages. As an example, linear devices such as operational amplifiers frequently use both positive and negative regulated voltages. The desired voltage ranges of these devices is from 0 to ±15V. In contrast digital circuits require much lower voltages for their logic levels, but have much higher current requirements than that of the linear integrated circuits.

It was with this thought in mind that the power supply circuit described in this section was designed. Its output voltage is 0 to ±15V at 200 mA for operational amplifiers and 0 to +5 at 2 amperes for digital gate circuits. Usually the amplifier designer needs equal positive and negative voltages. This design provides equal positive and negative voltage that track each other with one manual control. Current limiting is provided for both positive and negative outputs.

The low voltage digital voltage is adjustable to +3.8V for RTL logic and +5V for TTL logic. No current limiting is provided.

The complete schematic is shown in Fig. 2-60. The transformer and rectifiers must be chosen to meet the current and voltage requirements of the load. A 35V center tapped, 3 ampere transformer is adequate. The four rectifiers are connected to have outputs of positive and negative 20V and each full wave rectified voltage is heavily filtered by a large capacitor.

The reference voltage used in the design is a 1N5233 zener diode that is turned on by the positive unregulated 20V through a 1000Ω resistor. Considering just the 12V positive supply for the moment, it is noted that the series regulator consists of two transistors hooked in a Darlington pair connection to increase the effective beta. This assures that the limited output current of the operational amplifier can effectively control the output current.

The 741 op-amp compares the subdivided zener reference voltage to the subdivided output voltage and therefore forces the series regulator to make them equal. Current

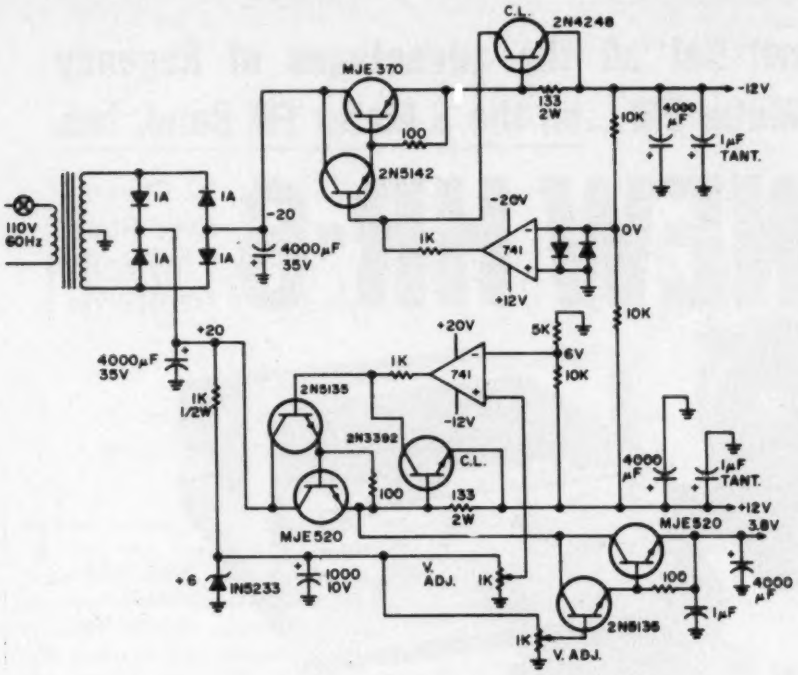


Fig. 2-60. Regulated power supply.

limiting is provided by developing a voltage across the 0.33Ω resistor and therefore causing the 2N3392 transistor to load down the op-amp. This causes the series regulator to partly turn off and limits the regulation. Under this condition, the series regulator is dropping the entire voltage at the maximum regulator current. Its dissipation capability must be adequate.

The negative supply operates in much the same way as the positive supply. The major difference is the use of PNP transistors. Current limiting is also provided here. The reference in the negative supply comes from an input from the positive supply. Instead of a zener reference diode being used, the two inputs to the op-amp are operated at near ground potential. One input is directly grounded. The other input receives its voltage from the center connection of two equal resistors which are connected to the positive and negative outputs. When the negative and positive power supplies have equal voltages, the input or center connection of the resistors is at ground potential. This is the necessary condition for balance. When the positive voltage is adjusted by the control, the negative voltage tracks it perfectly.

In all cases output filter capacitors are added to the output terminals to assure that the high frequency output impedance is low. One of these capacitors should be tantalum in order to give low high frequency impedance.

The logic supply is similar to the other positive supply. Again a Darlington pair is used to give the necessary beta control. The control reference is a pot, connected across the reference zener diode. The series regulator receives its voltage from the regulated positive 12V before the current limiting resistor. The MJE 250 in the higher positive voltage supply must be capable of supplying the current for both positive voltage circuits.

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THE CAN SCANNER

No camera? Get started on Slow Scan with a unit that produces high quality pictures from transparencies.

The can scanner may appeal to those of you who have just got a slow scan monitor operating and now need a quick, inexpensive method to make some pictures of your own to transmit. Further, the system may be expanded later into a plumbicon camera with only a coffee can to discard.

The can scanner idea appears as old as slow scan itself. Although I first heard of it from Bill W7ABW, when I told others later that I used a can scanner I found most of them had also started out with a can scanner.

The heart of the can scanner is the slow scan generator and dc amplifier of Ralph Taggart WB8DQT, described on page 89 of July, 1972 *73 Magazine* The reader is advised to read his article in addition to this one. The construction and alignment of the generator and dc amplifier is covered in full detail in that article, so they will not be repeated here.

A two-pound coffee can (with a 931 photomultipler tube and its associated 1 MΩ resistors mounted on the socket) in conjunction with your existing monitor, make up the scanner.

Notice, also, the can scanner may be used with either electrostatically or electromagnetically deflected monitors.

How It Works

A block diagram of the complete system appears in Fig. 1. The audio output of the

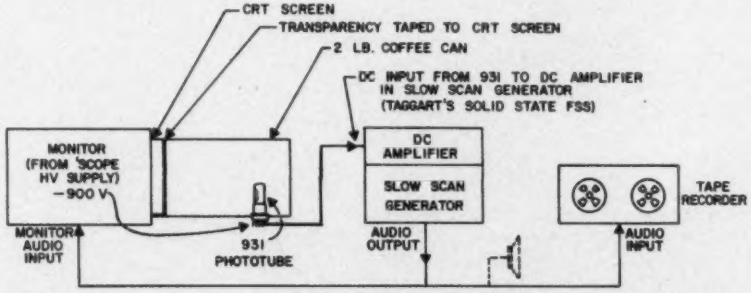

CRT SCREEN
TRANSPARENCY TAPED TO CRT SCREEN
2 LB. COFFEE CAN
DC INPUT FROM 931 TO DC AMPLIFIER IN SLOW SCAN GENERATOR (TAGGART'S SOLID STATE FSS)
MONITOR (FROM 'SCOPE HV SUPPLY) −900 V
DC AMPLIFIER
SLOW SCAN GENERATOR
TAPE RECORDER
MONITOR AUDIO INPUT
931 PHOTOTUBE
AUDIO OUTPUT
AUDIO INPUT

Fig. 1. Block diagram of the can scanner showing connections between the units.

"Can Scanner" being put into position for use.

generator is a composite slow scan signal. This is fed to both the tape recorder and monitor inputs. A previously prepared slide is lightly taped to the monitor crt face. Light from the initial trace will pass through the slide and onto the 931 grid. The 931 output is amplified by the dc amplifier and applied to the generator, providing the slow scan picture. This is now recorded for use on the air later. The system has one drawback: since the monitor is used as a "scanner" you cannot see the pictures as they are scanned; you must record them and then view them off the tape recorder. No big thing– after a couple of hours of practice you'll have it down pat.

Be sure to use a good quality (capstan driven) tape recorder, since wow will be doubled by recording and playing back on an inferior machine. Generally speaking, tape recorders that will record and reproduce music will also work fine for slow scan.

Note: One change is necessary in the monitor, so it will continuously sweep white regardless of the slow scan video frequency from the generator feeding it. Either run the contrast control to minimum or disconnect the video lead that modules the crt (usually applied across a 500K or 1 MΩ resistor on the control grid). This is only for scanning. It must be set back as usual for viewing pictures. Your monitor brightness control now doubles as a "scanning contrast" control.

Operation

Now to record pictures, remove the yellow filter on the screen if your monitor has one (the initial trace is used for scanning). Tape your slide or transparency to the screen, place the can with the 931 over this (Fig. 1) and record a few frames. Then remove the can and slide, rewind the tape recorder and play back the recorded pictures

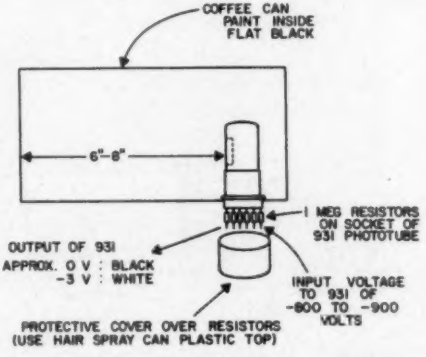


Fig. 2. Coffee can details of the scanner.

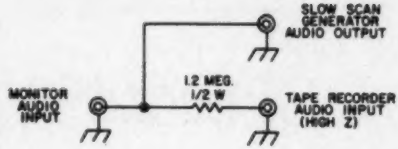


Fig. 3. Matching network between SSTV audio and tape recorder.

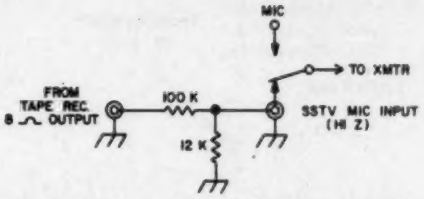


Fig. 4. Matching network between tape recorder and transmitter.

to check detail. This process can be continued until you have a group of programs recorded.

You might like to leave a blank space between each picture and write down, in order, what each "burst" (picture) is, so you can later splice them together in different orders. For example, splice 3 I.D frames to 3 photo frames and follow with 3 sign-off frames. Top this off with paper leader spliced onto the front and end of the "program" and write the description directly on this leader with a pen.

Remember to disable the monitor contrast when recording, and to set it back as usual when viewing (so you will view the pictures as others will).

The distance from crt screen to photomultiplier grid is six to eight inches.

The –700 to –900 volts for the phototube can be acquired from the high voltage divider string (probably between intensity and focus pot) of the monitor, as Taggart did, or a separate supply can be thrown together from junk parts (as I did). You could even tap off your transmitter HV supply, since you only need a few mils of current. (Watch your polarities!)

A temporary speaker paralleled with the recorder input will allow you to hear the picture before recording it. With a little experience – listening while watching a picture being scanned, you can approximate the proper setting of the monitor brightness control for proper scanned picture contrast. (It may be necessary to disconnect this speaker while recording due to the drop in tape recorder input level.)

A clear slide with only your call letters in the middle, for example, will sound pure 2300 Hz when the trace is at the top. Then a "cutting through" of the tone (popularly

Off-the-tube photos of the results obtainable with the "Can Scanner."

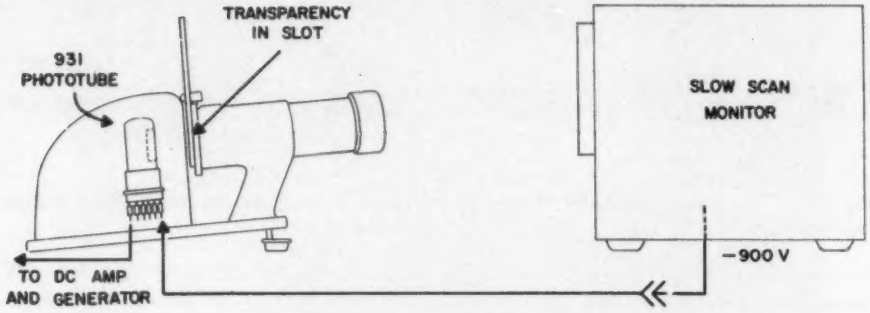


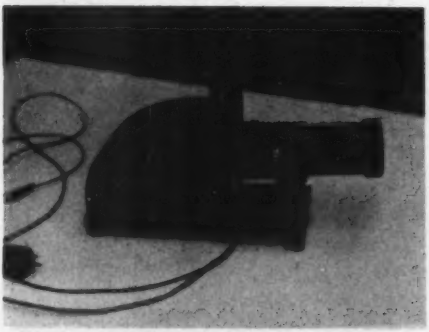
Fig. 5. Improved scanner using a modified slide projector.

referred to as a buzz saw going through a pine knot) as it passes the letters. Then pure 2300 Hz at it nears the bottom.

I mentioned earlier that this system could be expanded. The slow scan plumbicon camera which is featured in the *73 Slow Scan Handbook* uses this same generator. All you need add is the video amplifier, blanker, simple sweep circuits and plumbicon (with its associated power supply) and you have a top-notch slow scan camera.

If you place the two diagrams side by side, you can see the generator is half of the camera, and with this confidence, you'll probably tackle the camera later. Don't forget to keep the coffee can. Maybe the idea will inspire other innovations, or help a new slow scanner into our fascinating world.

The off-the-screen photos show the quality obtainable from the can scanner.



Slide projector "in reverse" ready for use with monitor supplying high voltage for the phototube.

Thanks go to Clarence K6IV for the photography.

A slightly more sophisticated "scanner" is shown in Fig. 5.

The coffee can is replaced with an old slide projector in which the 931 phototube (plus its socket and bank of 1 meg resistors) is centered in the space previously occupied by the projection lamp. The modified projector, with the slide you want to record inserted in it, is now trained on the monitor. (Remember to disconnect the video lead on the monitor's crt grid, so it will just sweep white). Now you can make up continuous programs by just feeding slides into the projector . . . either color, black and white, or home drawn with felt pens on clear plastic 2 x 2 in. squares. I found the best and quickest way to focus this "scanner" was to place a *thin* piece of paper in the slide holder, like it was being scanned, and focus the picture from my 5 inch Sony TV onto this. I did this in a dark room, placing the Sony TV about 14 in. from the projector. When I could see the picture *sharply* on the thin paper, I cut on the lights, and measured my lens length, and distance to Fast Scan (Sony) TV. This, no doubt, saved hours of Slow Scan adjusting. I suggest you borrow a friend's Slow Scan monitor when you set this up the first time, so you can make fine adjustments on focus and scanning brightness, while viewing them on a monitor. When you do get them right, be sure to measure and mark all dimensions.

. . .K4TWJ

John J. Schultz W2EEY
1829 Cornelia Street
Brooklyn NY 11227

IMPROVING THE INDOOR ANTENNA SYSTEM

The use of thin copper sheeting is featured to construct efficient, broad-band indoor antenna systems of either the single-band or multi-band variety.

Having to work with an indoor antenna system inside an apartment or house is, of course, a major handicap. No indoor antenna system will ever work as well as an outdoor antenna system constructed of the same materials, at the same height, etc. However, rather than take the defeated approach to the indoor antenna problem, it is very worthwhile to examine the possibilities concerning what things can be done better with an indoor antenna system than with an outdoor antenna system. After all, using an indoor antenna system, the materials used are not subject to the same wear or stress requirements as those on an outdoor system, the antenna is usually more accessible to make adjustments, etc.

Keeping these thoughts in mind, I decided to explore a somewhat different technique for the construction of an indoor antenna system. One of the chief factors that is desired to achieve in any antenna system is low-loss. That is, regardless of how good the matching is to an antenna system to transfer power to the system, one still wants to keep the basic Ω loss of the system as low as possible. Such a condition insures at least that each delivered watt of power really radiates and also leads the way to the development of a broad-band or multiple-band antenna system which does not require critical tuning.

Searching around for materials to use for an indoor antenna system, I finally found the ideal material in the form of copper sheeting. Of course, most amateurs would have been using such material if it were as readily available as common household aluminum foil. But, with a little bit of effort, one can find an almost similar form for copper The advantages are numerous as compared to the aluminum foil material various amateurs have used for the indoor construction of loop or dipole antenna systems. The losses of copper are far lower and the copper can be directly soldered with ordinary soldering materials. Unfortunately, one can't walk down to the nearest hardware or grocery store and obtain a roll of thin copper. But, it can be found by searching out the various wholesale metal product outlets. If one gets back far enough in the suppliers' chain, it will be found that the metal is sold on the basis of weight. In my case, hard drawn copper sheeting about 12" wide and 4/1000" thick was found selling at about $2 a pound. The total cost would depend upon the length of sheeting purchased. For a typical 3 band antenna system (described later), the cost was about $10. The 4/1000" material is by no means as

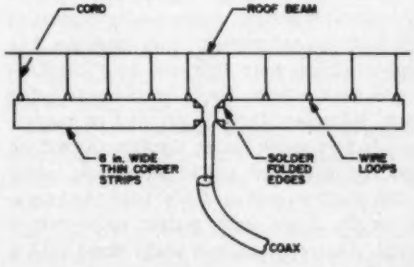


Fig. 1. Basic dipole constructed from thin copper strips.

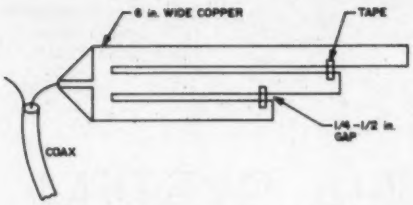


Fig. 2. One half of a tri-band dipole.

fragile as it sounds when one considers that regular foil is still only a fraction of this thickness. One may ask, why fuss to obtain such copper sheeting or foil when, if copper is so desirable, copper tubing is readily available from plumbing supply houses. The advantage of the sheeting is that one obtains far greater surface area for less cost with the sheeting and it is far easier to handle and form in different antenna shapes.

A Practical Antenna

One of the simplest but most effective indoor antennas which one can construct if space is available in an attic is an ordinary dipole. In my case, one dipole antenna which was constructed is shown in Fig. 1. The 12' wide copper sheeting was cut with a pair of heavy shears to two strips of 6" width and each strip used as the arm of a dipole. Little loops of wire were soldered to the top edge of each sheet at intervals and these loops used to attach plastic cord which in turn was used to suspend the antenna from a roof beam, at about a 12" spacing from the beam. At the center of the antenna, the copper strip was folded together towards the center where the coaxial feedline was attached. The folded over edge of the strips was soldered along each edge to the body of the copper strip. This was done to insure absolutely minimum resistance at this high current portion of the antenna. The copper strips were first cut to "formula" length for a regular dipole on the band being used. However, there is no way to predict exactly how much longer the antenna will be than required. One has to use an swr meter in the feedline and carefully trim the antenna length down until proper resonance is found. This procedure is easily done with a pair of shears, trimming the copper stripping down equally at both ends of the dipole until a 1:1, or as close as possible to 1:1, swr ratio is achieved in the center of the band for which the antenna is cut. This procedure requires patience but it is absolutely essential. One of the greatest faults made with indoor antenna systems of the self-resonant type is that many operators forget that the capacitance of the building structure surrounding the antenna completely changes its resonant frequency. The antenna must be cut for resonance where it is mounted or one will end up blaming the indoor location for poor performance results which are not really justified.

A Multi-Band Antenna

The use of the copper stripping to construct an indoor antenna really demonstrates its versatility when constructing a multi-band parallel dipole type of antenna system. The multi-band type of antenna about to be described can really be made for any combinations of bands, although the space available in most indoor situations will allow it to be constructed for only 20, 15 and 10 meters or some two band combinations of these bands. The basic multi-band antenna is constructed for the lowest frequency band to be used the same as the antenna shown in Fig. 1 and tuned up for operation on this band. Then each side of the basic dipole is cut using shears to form either two or three strips out of each dipole side as shown in Fig. 2. Try to cut the copper so there is about a 1/4" gap between the strips. Now, if the basic dipole were cut for 20 meters, the center strip would be cut back equally on each side of the dipole until the antenna resonated properly on 15 meters. Then the

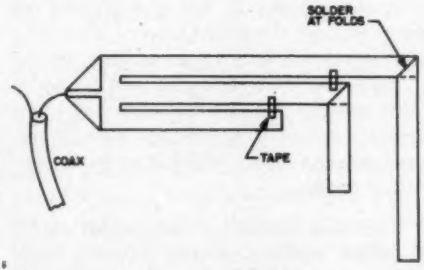


Fig. 3. A space-saving version of the multi-band dipole element of Figure 2.

bottom strip would be cut away equally on both sides of the antenna until the antenna resonated properly on 10 meters. Little pieces of tape placed periodically between the strips will be more than adequate for physical support. The large area surface of the antenna is such that trimming of the strips to form dipoles on each band does not appreciably affect the resonance on any one band. However, one should recheck the resonance on each band. Corrections, if necessary, are easily done by soldering on a few inches of copper stripping cut off during the tuning process on each end of the dipole strip. Solder on these correction strips vertically on the end of each dipole strip.

The same procedure can be used to construct almost any form of dual or tri-band antenna when there is sufficient space to run a dipole on the lowest frequency band being used.

Variations

The ease with which the copper stripping can be bent and, particularly, soldered makes it possible to vary the construction of an indoor antenna to suit almost any situation. For instance, as shown in Fig. 3, if not enough space is available to run out a full length dipole, the dipole strips can be bent to hang vertically at the end of the antenna to make up the necessary length. Inductively loaded or trap antennas are also easily constructed by soldering the necessary components between sections of the copper stripping. A 80-10 meter loop antenna can be formed as shown in Fig. 4 by constructing as large a loop in the attic as space will permit to be hung and using a trans-match type of tuner to resonate the system. Don't hang such a loop horizontally unless it is relatively small and operation is desired only on the 80 or 40 meter bands. The reason for this is that the dominant radiation from a loop will either be broadside to the plane of the loop or along the plane of the loop or a combination thereof depending on the relationship of the loop size in wavelengths to the frequency being used. A horizontally placed loop operated on the higher frequency bands might well operate in a mode such that the dominant radiation is wasted because it is straight up and down.

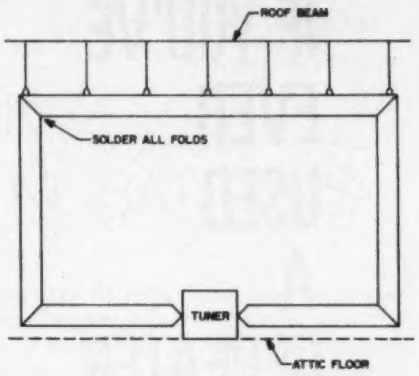


Fig. 4. A multi-band loop for suspension in an attic.

Baluns

The use of a balun for an indoor antenna system is highly recommended. There are usually enough problems with rf fields with indoor installations because of the close proximity of the station equipment and the antenna that it doesn't pay to aggravate it by additional "rf on the feedline" problems. Inexpensive home brew or kit-type toroid baluns can be used since no weather protection is necessary. I used a kit-type toroid balun placed directly between the dipole elements at the center. The toroid winding ends were soldered directly to the copper stripping which formed the dipole and to the coax feedline.

Conclusions

The usage of indoor antennas is also often associated with lower power operation so that one suffers a double handicap. The use of copper stripping as described goes just about as far as one can economically go in keeping antenna losses low. So, if one can match whatever power is available correctly to the antenna, at least one source of loss can be minimized.

A word of caution when handling copper stripping, especially the hard-drawn type. With normal care, there is absolutely no problem handling the material. However, the edges when cut with shears can become like knife blades. Keep the kids away or tape the edges.

...W2EEY

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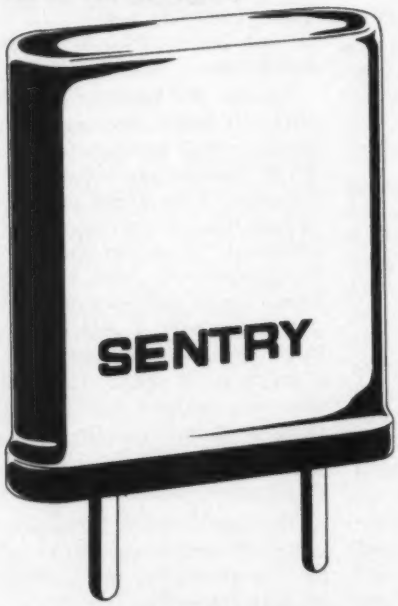

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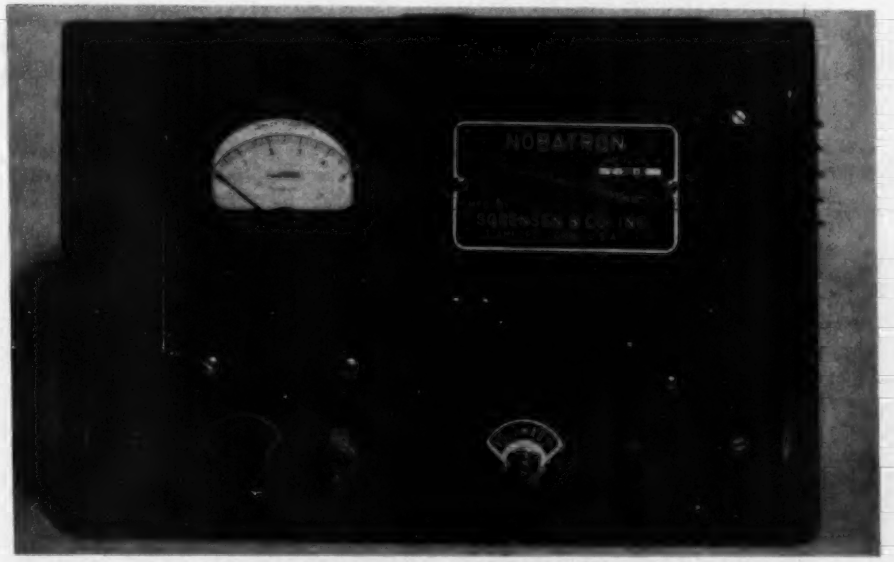
UPDATING SORENSEN "A" NOBATRONS

Prior to the transistor era, regulated low voltage dc power supplies were difficult to build. At the same time, there was not a great demand for such supplies since electronics meant vacuum tubes. The main use of high current, low voltage dc supplies was for either battery-charging or electroplating, neither of which requires superb regulation or ripple reduction.

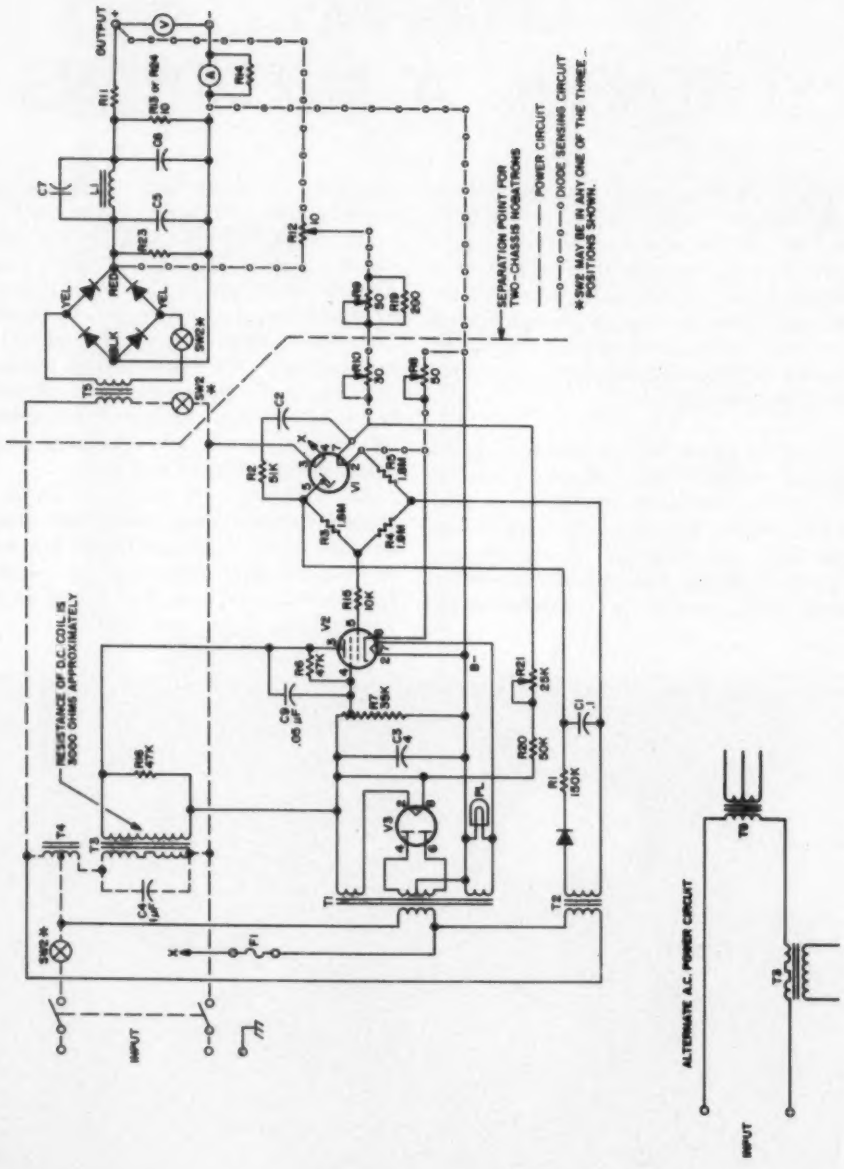
The Sorensen "A" Nobatron E-28-5 is typical of pretransistor low voltage supplies. It is bulky and heavy, constructed of disc-type rectifiers and saturable reactors, and has very slow response to line or load variations. Perhaps the most serious problem with having an old "A" Nobatron is the possibility of failure (and consequent high cost of replacement) of the sensing diode.

In the E-28-5, a 2AS15A sensing diode was used, whose replacement cost is about $10.00. I don't mean to knock the principle of using a temperature-limited diode to sense "true-rms" voltage, because it is one of the *best* methods. The trouble is that the time constant of the diode filament is the main factor in the slow response of the system, and the tubes are solely available from Thermosen at relatively high cost.

In updating my E-28-5 Nobatron I salvaged only the power transformer, choke, and electrolytic capacitors (plus a few peripheral components like the switch and fuse holder). This may seem like "jacking up the



The updated E-28-5 Nobatron.


OUTPUT
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DIODE SENSING CIRCUIT
*SW2 MAY BE IN ANY ONE OF THE THREE POSITIONS SHOWN.
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INPUT
ALTERNATE A.C. POWER CIRCUIT
INPUT

Fig. 1. Circuit used in conversion of the E-28-5.

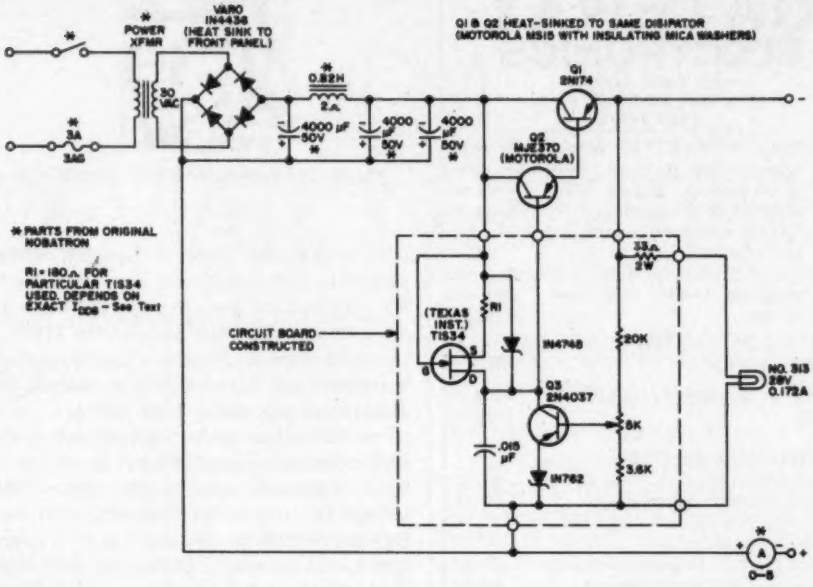

Fig. 2. The rebuilt Sorensen E-28-5.

radiator cap and moving a new auto under," but the components salvaged represent three-fourths of the cost of the new supply.

Table I shows the various types of Nobatrons that one may encounter; the conversion principle shown here for the E-28-5 is generally applicable to any of these. One of the startling improvements is the reduction in size and weight. For instance, the finished E-28-5 (photo) weighed in at 30 pounds, some 35 pounds lighter than when the modernization was started. There are a couple of "A" Nobatron models with output current ratings of 100A or more; even these models might be converted, say by using a pair of the newer high current transistors like the RCA 2N5575.

In the conversion of the E-28-5, a simple transistor series regulator in the secondary circuit replaces the old saturable reactor regulator in the primary circuit. A PNP negative-side regulator was used, but it could have as easily been made an NPN positive regulator. Figure 1 shows the actual circuit.

The circuit uses an FET as a constant-current source to provide the load resistance for Q3. In this way, a much higher dynamic load impedance for the dc amplifier (with consequent higher dc loop gain) is obtained. The FET is picked to have an Idss higher

TABLE I
Weight and Input Currents

Model	Net Weight Lbs.	Input Current Amps.
E-6-5A	65	2.5
E-6-15A	65	4.5
E-6-40A	90	10
E-6-100A	230	26
E-12-5	70	3.0
E-12-15	75	7.0
E-12-50A	170	23
E-28-5	65	6.0
E-28-10	70	10
E-28-30	180	28
E-28-70	475	35
E-28-150	500	31
E-48-15	230	28
E-125-10	200	33
E-200-5	240	33
DE-6-40	65	10
DE-12-10	55	6.0
DE-28-10	60	10

Information on different types of Nobatrons. Code: Number following "E" indicates voltage. Number following voltage indicates current.

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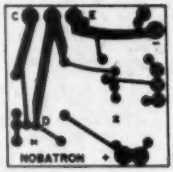

Fig. 3. Circuit board for smaller components.

than 6 mA (the value of constant current desired in this circuit) and then the value of R1 adjusted to give the correct value of constant current. Since I_{dss} for the TIS34 is specified from 4–20 mA, a few from "off the shelf" will have insufficent current, but TIS34's are only about $1.00 each.

A 22V zener diode is placed across the FET constant current source to protect it from transients, since it has only a 30V rating. The two series transistors (Q_1 and Q_2) are wired in the Darlington configuration, and mounted on the same heat sink.

A simple circuit board has been laid out to accommodate the smaller components.

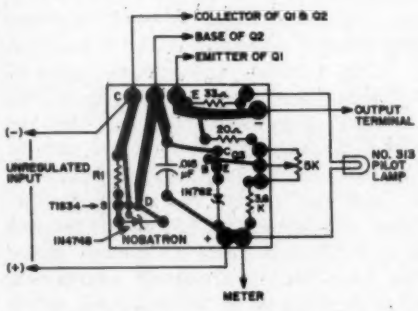

Fig. 4. Parts placement on circuit board.

This board is shown in Fig. 3. Boards and parts are available from Project Supply Co., P.O. Box 555, Tempe AZ 85281.

Further information on the type "A" Nobatron is available from Sorensen (a division of Raytheon), Richards Avenue, South Norwalk CT; ask for publication No. 106A. The Sorensen Company still uses the "Nobatron" trade name for their extensive line of solid state low voltage power supplies.

. . .W6GXN

Vern Epp VE7ABK
Box 371
Nelson, British Columbia

FM DEVIATION METERS

Build your own with an FM receiver and oscilliscope

One of the most important elements of amateur growth has been the use of VHF FM. Its growth has surpassed most predictions as Japanese and American manufacturers are flooding the market with excellent quality two meter equipment.

Most of us grew up with AM, the old standby. Unlike amplitude modulation, the term percentage modulation means very little in FM practice. In FM we use the term deviation when the transmitter is modulated, the carrier shift is in frequency on either side of its center frequency. This is called deviation. Deviation is normally measured in kHz, and in a properly operating FM transmitter it will be directly proportional to the amplitude of the modulating signal. When a symmetrical modulating signal is applied to the transmitter, equal deviation on each side of the carrier frequency is obtained during each cycle of the modulating signal, and the total frequency range covered by the FM transmitter is known as swing; e.g., a transmitter operating on 5000 kHz is shifted to 4990 and then to 5010 kHz. It is deviating ±10 kHz and has a swing of 20 kHz). To measure this swing requires special test equipment. There are two main types of deviation meters: one employs a meter to read the peak deviation and the other uses a cathode ray tube.

Deviation Meter Utilizing A Meter

The Lampkin FM modulation meter is shown in Fig. 1. It is completely tunable and will measure peak frequency deviation either positive or negative. Here's how this works. A signal from a transmitter to be measured is picked up by the antenna and fed into the mixer along with a VFO whose output, or harmonic, when adjusted will produce an i-f frequency. The i-f amplifies the signal and its output is fed to the limiter which cuts down the signal to a fixed level of voltage, free from amplitude modulation or variation due to input strength. The discriminator changes the frequency change to a proportional dc change. An on-frequency signal would produce zero volts directly from the discriminator load resistor. The audio voltage is impressed on the cathode follower tube. The purpose of the follower is to provide a low source impedance for charging the input capacitor of a shunt fed rectifier. The time constant is such that the rectifier charges quickly and accurately to the instantaneous peaks of modulation just long enough for the indicating meter to respond and to be

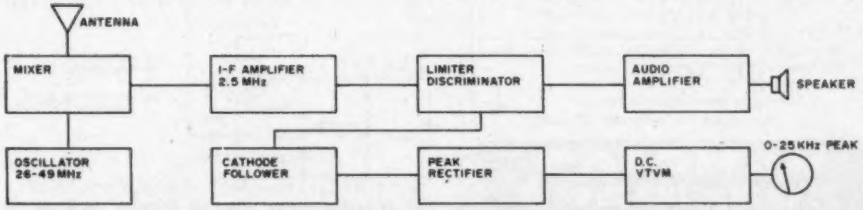

Fig. 1. Block diagram of Lampkin type 205A FM modulation meter.

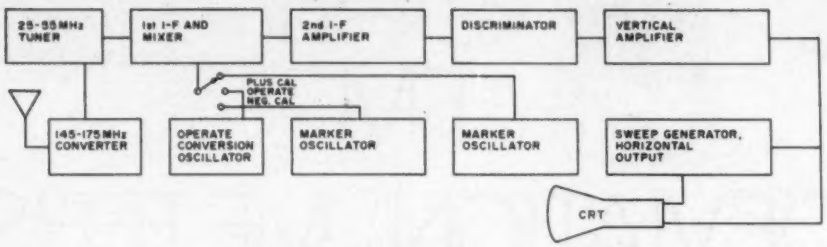

Fig. 2. Block diagram of Radio Specialty Mfg. No. 1163.

read accurately. The meter is calibrated for peak swing on the transmitter.

Deviation Meter Utilizing a Cathode Ray Tube

The Radio Specialty Deviation meter is shown in Fig. 2. The deviation meter is basically a tunable FM receiver and a direct coupled oscilliscope in one package. Peak deviation can be seen visually by calibrating the face of the cathode ray tube. By modulating a transmitter with a sine wave and watching the deviation meter distortion and limiting, if any, can be seen. Calibration of the unit is achieved by the use of marker oscillators 10 kHz above and below the operating frequency of the second oscillator. The vertical gain of the vertical amplifier can then be set to correspond with the markings on the face of the CRT.

Building Your Own Deviation Meter

The deviation meter just described can be built by using an FM receiver (fixed or tunable) and an oscilloscope with a vertical amplifier which is direct coupled. A narrow band receiver is superior to the broad band because of the increased discriminator sensitivity to frequency change. Calibration can be accomplished a number of ways. Figure 3 shows a block diagram with the calibrating oscillator. This oscillator should be tuned either 10 or 15 kHz above or below the second oscillator. The cathode ray tube face can then be calibrated accordingly. One calibration oscillator should suffice since a transmitter usually deviates equally well both ways, however another one would assure greater accuracy.

Operation

1. Switch S1 to normal
2. Turn on transmitter to be checked and tune in signal (or switch proper crystal in). A straight horizontal line will show up which will move up and down with tuning. Adjust for center of the screen.
3. Switch S1 to calibrate. The horizontal line

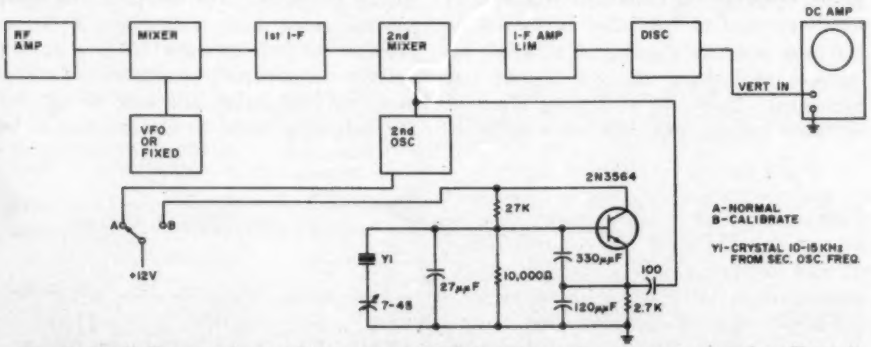

Fig. 3. Block diagram of an easily constructed FM deviation meter using an external oscillator in conjunction with an available receiver and oscilloscope.

will now move either up or down. Adjust vertical gain for a reasonable display and mark on the face of the tube. The unit is now calibrated for deviation limits as determined by the difference of the two oscillators. Additional markings can be added to the face of the tube for lower deviations.

4. Modulate the transmitter to be measured while watching for peak modulation.

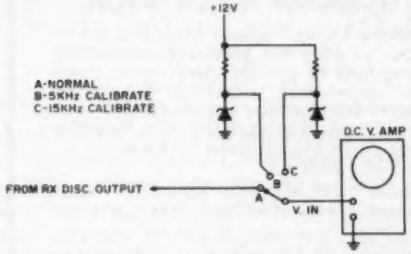

Fig. 4. Alternative circuit using zener diodes to locate the 5 and 15 kHz marks on the scope face.

Alternative Circuit

The calibration circuit as shown in Fig. 4 can be used if desired. A signal generator must be fed into the receiver with a multimeter connected to the discriminator secondary to measure the dc voltage change versus the frequency change of the receiver. Record the voltage at 5 kHz and 15 kHz off. The correct zener can then be selected to supply a reference voltage to calibrate the oscilloscope. If a zener cannot be found with the correct voltage drop then a potentiometer across a higher voltage drop type will suffice.

Summary

An FM deviation meter is a useful addition for the workshop and the hamshack. Overmodulation as on AM will cause distortion. Now you can keep close tabs on the repeater as well as fellow hams' deviation.

. . . VE7ABK

References
1. Radio Specialty Mfg. Co Model 1163 Deviation Meter.
2. Lampkin Model 205A Lampkin Laboratories Inc.

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TIME-FREQUENCY MEASURING SYSTEM

PART III

This is the third of a three-part series describing the component parts of a time/frequency measuring system for a well-equipped amateur radio station and workshop. The amateur can calibrate this system to an accuracy of better than one part in 10^6 (.0001%). This system, which was described in detail in the first part of the series, consists of a clock/time base unit and frequency counter unit. The clock is used to calibrate the time base by the time drift method. The counter normally uses the time base in the clock unit for precision measurements, but has provision to operate independently with the power mains as a time reference.

The time drift method of calibrating a precision frequency standard allows the amateur to achieve accuracy far better than traditional methods, without requiring any calibration equipment other than a WWV receiver and his own patience.

Description of Counter

The counter described here has the capability to make precision frequency measurements from 5 Hz to above 220 MHz with more sensitivity than most commercial counters, 20 mV or less over the whole range. The accuracy is that of the time base described before (between .00001 and .0001%). When the power line is used for the time base, accuracy is better than 0.1%.

The display is 6½ digits of seven bar incandescent (no high voltage neon tubes) which is compatible with the accuracy of the instrument. Some other counters have 7 or 8 digit displays that are pure bluff if they don't have the 10^7 or 10^8 accuracy time bases that such displays would seem to represent.

Many other counters have one count errors (which can be significant at low frequencies) caused by the turning on of the gate itself. This counter prevents this by using a very narrow trigger pulse, as explained in detail later. Low frequency errors are further reduced by the use of a Schmitt trigger to get positive switching even on slowly-changing wave-forms, and a ten-second gate for better resolution.

One-second and 0.1-second gates are used for medium and high frequencies, and a prescaler is switched in for upper HF and VHF.

Basic Counter Theory

The principles of operation of this counter may be seen by referring to the block diagram, Fig. 7.

The counter, which may also be called a totalizer or accumulator, is the heart of the frequency counter, hence the name. This section counts all trigger pulses fed to it while it is enabled, then displays the total. By resetting the counter to zero periodically,

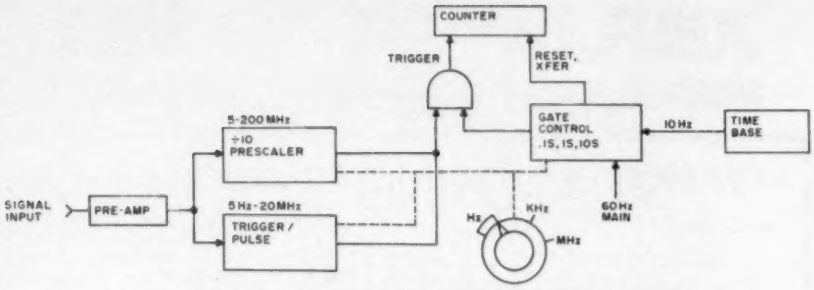


Fig. 7. Overall block diagram of the frequency measuring system.

then allowing it to count for a precise time period, a frequency is displayed. For example, if the counter is turned on (gated) for exactly one second, the total count at the end will be the frequency in cycles-per-second of the triggering signal. After the counting is over, the count is stored in memory units (latches) to be displayed while the counter is reset to start another count.

The gate control section, driven by either the precision time base or the power line, generates the precise enabling gates to turn on the counter. It also generates the transfer pulse to transfer the count to the latches at the end of each counting period, and the reset pulse to put the counter back to zero in preparation of the next count. Longer gates are used for counting slower frequencies, and vice-versa.

The trigger pulses for the counter are developed from the input signal through one of two paths, depending on the frequency. Signals with frequencies of 5 Hz to 20 MHz may be handled by the trigger/pulse generator section. This is selected automatically by selecting Hz (10-second), Hz (1-second), or kHz (.1-second) gating. Signals from 5 to 220+ MHz may be processed through the prescaler by selecting MHz.

The pre-amplifier boosts the signal to a level sufficient to drive either the pulse generator or the prescaler. The frequency response of this section is flat from 10 Hz to 10 MHz, requiring only 10 mV for reliable triggering throughout this range, rolling off at 6 dB per octave above and below. Up to 20 mV is required at 5 Hz and 20 MHz. The prescaler is more sensitive than the pulse generator, so 20 mV sensitivity is maintained up to 200 MHz.

Decimal Point Indexing

The decimal point is set in the display automatically to agree with the gate timing and prescaler division.

In the upper Hz position on the selector switch, a one-second gate is selected and there is no decimal point (assumed to be at the right edge). Here the counter reads directly in counts-per-second (Hz).

When the lower Hz position is selected, a ten-second gate is switched in and the decimal point appears one place in from the right. Ten times as many triggers are counted, so the display reads tenths of Hz.

When the kHz position is selected, the decimal would move in three places, except that the gate is shortened to 0.1 second, cancelling one of those places. Thus the display has a decimal point in two places from the right and reads hundredths of kilohertz (to nearest 10 Hz).

When the MHz position is selected, the decimal would move three places more to the left from the kHz position, except that the divide-by-ten prescaler is switched in, cancelling one of those places. Thus the display has a decimal point in four places from the right and reads ten-thousandths of MHz (to nearest 100 Hz). No accuracy is lost by not having finer resolution as ±.0001% of 200 MHz is ±200 Hz which is the accuracy of the time base.

Overflow

The ½ of the 6½ digit display is a 1 which may appear to the left of the six full digits. This is connected to the overflow counter to show that the count exceeded the six-digit capacity of the counter. I chose to use a "1" instead of another kind of indicator because

throughout most of the range of the instrument an overflow *is* a 1 so the display reads correctly, and adding the 1 to the six-digit display costs very little. This reads incorrectly only if the count exceeds 200 MHz in the MHz position, 20 MHz in the kHz position, 2 MHz in the Hz position, or 200 kHz in the low Hz position. In the last three positions simply selecting the next higher range will show if the 1 is correct.

Leading-Zero Suppression

A nice, though not necessary, feature in this counter is blanking of unneeded zeros on the left of the display. With this blanking, for example, a 400 Hz frequency would read out "400" and not "000400." Logic for this function is provided already in the display decoders so it is a "free" feature.

DESIGN THEORY

Counter-Latches

The counter consists of decade counters, latches, decoders and displays as shown on Fig. 8, detailed block diagram. The operation of all these except the latches was covered in detail earlier and will only be reviewed here.

The decade dividers are 7490 integrated circuit (IC) modules, connected to divide by 2 before 5 so as to count up in standard binary-coded-decimal (BCD). Six decades are used, one for each full digit.

A faster-than-normal 20 MHz 7490 must be selected for the critical first decade. The specs. only guarantee 10 MHz, which is good enough for all other places.

The latches are 7475 quad latches, meaning there are four type D flip-flops or memory elements in each IC.

A type D (data) flip-flop has two inputs, D and clock. It stores the D input at the instant the clock switches up. Here, a clock pulse occurs immediately after a count is finished, transferring the count data from the decade dividers to the latches. Then the latches hold the data to be displayed while the dividers are free to do the next count.

The decoders convert the BCD data to the code used by the displays. There are several display/decoder combinations available, as discussed previously. I have used the

The rear view of the counter shows the perf-board construction used by the author. The board along the rear edge is the input circuitry and pre-scaler. The power supply is at the left side with the regulator using the side itself as a heat sink.

epd MOD-KITS

UNIVERSAL DCU/DRIVER

These universal counting modules have heavy duty outputs to drive all 7 segment displays requiring up to 15V and 40mA per segment. TTL used throughout. Requires 5 volt @ 120mA per module and any number of modules may be cascaded. Typ. count rate is 20MHz except the NR-3H which is 70 MHz. Will drive any display in this ad (not included).

NR-3 Modulo 10 Counter 20 MHz $7.95

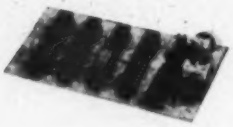
NR-3A Modulo 6 Counter 20 MHz 7.95

NR-3H Modulo 10 Counter 70 MHz 8.95

NR-3B Modulo 12 Counter clock 12.95

The most versatile multi-digit counting kit ever offered!! Comes with 5½ digits of counting and 7 segment decoding with the same heavy duty outputs as the NR-3. Typ. maximum count rate is 70 MHz. Each counting stage is completely independent allowing a custom approach to your application. The "+" and "—" sign are great for DVM or over-under circuitry. The overrange stage also has an overflow latch and reset buffer. Displays not included. PC board is 3½" x 6".

NR-3FM Multi-Stage Counting Unit $33.95



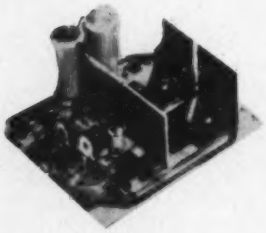
CRYSTAL FREQUENCY STANDARD

Contains a .002% crystal oscillator with TTL decade dividers to give output frequencies of 10, 1 MHz, 100, 10, 1 kHz, 100, 10, 1, & 0.1 Hz. Kit requires 5 volt supply @ 175mA. Uses low TC components and has zero-beat trimmer. Great for freq. meter, digital clock, etc. W/ complete instructions. CRO-1D $22.95

LINE CLOCK SOURCE

The DCC-2 derives precision gating and clock signals from the 60 Hz line. The input is a combination schmidt trigger and integrator which eliminates false triggering from line noise. The input is over-voltage protected and requires no adjustment. TTL compatible output frequencies are 10, 1, 0.1, & 0.01667 (1 pulse/min.) Hz. PC board measures 1.2" x 3.5".

DCC-2B Line Frequency Standard $9.95

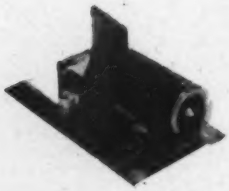


ANALOG POWER SUPPLY

Power your OP-AMPS with this versatile, low cost, dual-polarity regulator. One control varies both outputs simultaneously over the range of 0-15V. Electronic current limiting may be set separately for each output over the range of 25-200mA. Regulation is 0.1% and the ripple is below 3mV RMS. All parts conservatively rated for long life.

APS-5A Op-amp Power Regulator $13.95

TR-200 Transformer for APS-5A 3.95



LOGIC SUPPLY REGULATOR

Both kits have an output range of 3.3V to 5V with current limiting and short circuit shut down. Regulation is 1% and ripple & noise is 10mV RMS. Heavy duty components insure long life and allow rugged use.

DPS-1A Output current 0.6A $7.95

DPS-2A Output current 2.2A 10.95

TR100 Transformer for DPS-1A 2.29

TR1500 Transformer for DPS-2A 4.50

LED READOUT MODULE · COUNTER · LATCH · DRIVER

This new module has all the most desirable features required in counting and display. Fits 18 pin connector. 5V supply. All TTL logic. 20 MHz count rate.

$15.95

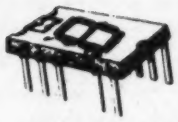
Miniature 7 segment display mounts in 16 pin dual in-line socket. 5V operation at 8 mA. per segment. 100,000 hr. life. W/decimal pt.

3015 Miniature Display ..... $3.45 3/$10.00

LARGER 7 segment display as pictured with the NR-3 series kits. Bright numerals can be seen even in direct sunlight. Mounts in 9 pin miniature socket supplied with the kits.

2010 7 Segment Display 0-9 DP $4.45

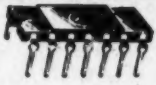
2020 As above except "1" "+" "—" 3.95



LED

Electrically and physically identical to the popular MAN-1. Has higher light output than MAN-1. Includes LH decimal point. W/spec sheet & app information.

LED700 7 Segment LED Display $6.95
(QUANTITY DISCOUNTS AVAILABLE)

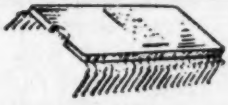


The 1101 Random Access Memory (RAM) will store and readout 256 bits. The chip is TTL compatible and comes with a complete spec sheet w/applications.

1101 256 Bit RAM $8.95

Build several instruments with this chip and little else. First really useful LSI chip for the experimenter. Contains:

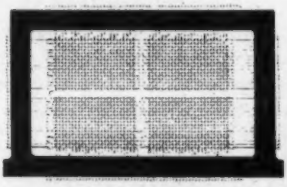
- Four decade counters + overrange
- Four 4 bit latches w/BCD outputs
- Seven segment decoder
- Display multiplexing circuitry
- Two programmable oscillators
- Single 5 volt supply at 5mA ! ! !
- Inputs TTL compatible
- Housed in 28 pin dual in-line pak



LSI

Comes with 16 p. booklet of specs & app notes. Booklet contains interfacing info on all seven segment displays made.

5002 LSI Chip $19.95



At last! Noncritical memory planes for the experimenter. Made by Ampex for IBM spares. They were removed from NEW core stacks. The large 50 mil cores allow the use of the most inexpensive sense amps. The cores are in an 80x50 array. All the necessary core specs are included with each plane. Available is an 80 page booklet describing an 8 bit x 1000 word memory using the MP-2A. Parts lists, schematics, and app notes are included in the booklet.

MP-1A 4000 Bit Core Plane $12.95

MP-2A 16K Core Stack 47.50

MPB-1 80 Page Core Memory Booklet 5.00

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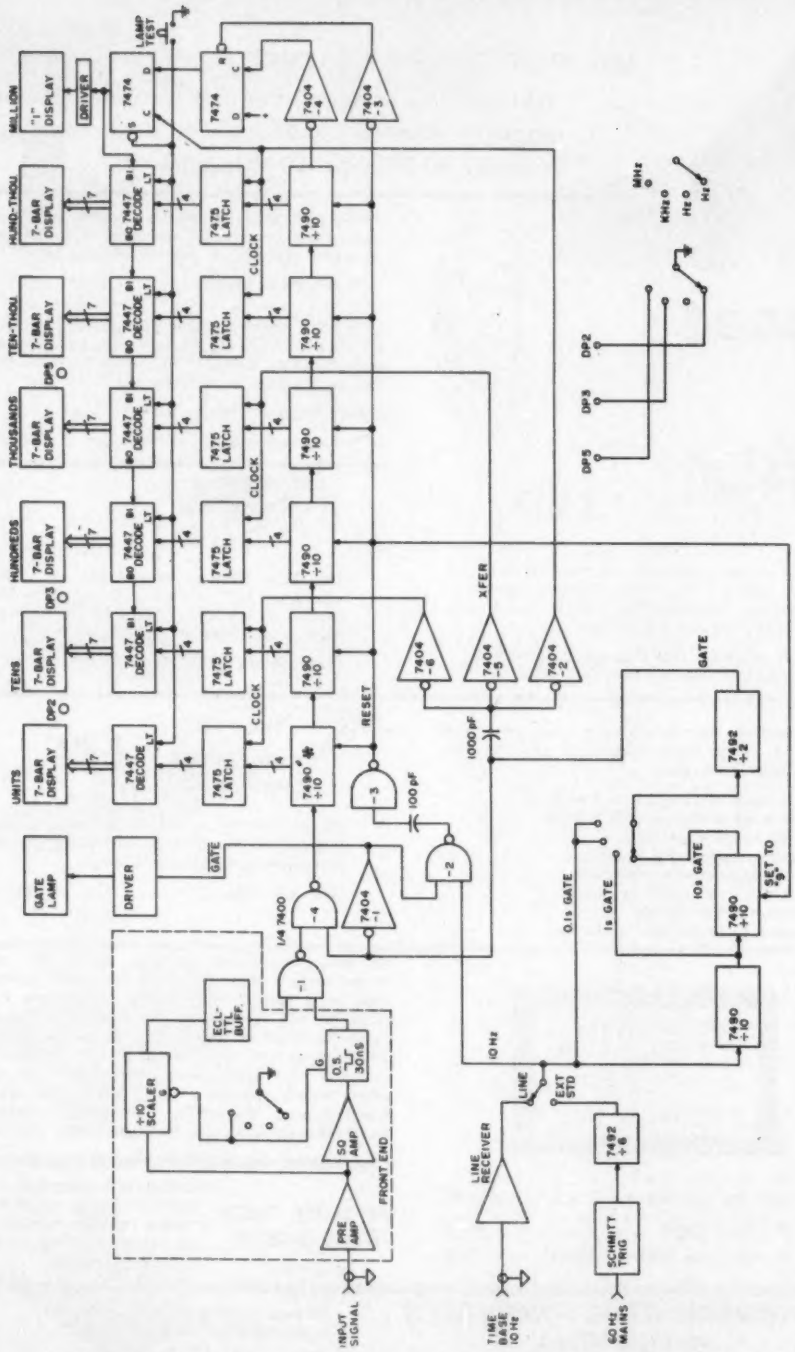

*Fig. 8. Detailed block diagram of the frequency counter. The 7490 identified by * should be selected for > 20 MHz switching speed.*

popular seven-bar segment with low-power lamps, and the corresponding 7447 decoders.

The leading-zero blanking described is implemented by connecting the blanking input (BI) of each decoder to the blanking output (BO) of the next higher digit, or to the overflow bit at the high end. If the overflow bit is a zero (0 volts), it enables the BI input of the Hundred-Thousands decoder. If the HT digit is also a zero, internal logic in the 7447 decoder will blank all lamps in that display and put out a zero on the BO output, passing the blanking signal to the next lower digit. Thus a zero on any BI input indicates that all higher digits are zero. If the BI input is a one (4 volts) then that decoder will display a zero in the normal manner.

Overflow

As discussed above, an overflow detector is used to indicate when the count has exceeded the capacity of the counter. This is like another 1-bit counter except that it only counts up once; i.e., continued or excessive overflowing causes no further change.

A D flip-flop is used as the overflow counter. The D input is permanently wired to a "1" signal so the flip-flop always goes to a 1 when it is clocked by an output from the last decade divider. It is reset at the end of each count with the decades.

Another D flip-flop is used as a latch for the overflow bit in the same manner as for the rest of the display data. A 7474 dual D flip-flop puts both functions in one IC.

Time Base 10 Hz Generation

Because the shortest gate period used in the counter is 0.1 second, the time base signal used must be 10 Hz or faster. A 10 Hz signal is available in the time base unit and also may be derived easily from the 60 Hz power line with the divide-by-6 section of a 7492 IC (7490 for 50 Hz). Selecting a 10 Hz signal to drive the gate control section thus makes a convenient way of selecting time bases, and only one coaxial cable is necessary to connect the time base unit to the counter unit.

A line receiver is used to convert the low voltage 10 Hz signal on the 90 ohm coaxial cable to the standard TTL logic signals used in the gate control logic. Main power from the power transformer secondary is coupled to a buffer gate which develops the 60 Hz time base signal.

Time Gate Generation

7490 decade dividers are used to derive the 1-second and 10-second gates from the 10 Hz signal, while the 0.1-second gate comes directly from the 10 Hz line. The actual gate itself (GATE) is generated by a divide-by-2 counter. This makes symmetrical gating for the 0.1 and 1 second gates, meaning the divider is true (gate on) for one time base period, off for one period, on one, etc. To avoid waiting so long between gates on the 10-second gate, the decade divider that generates this long gate is short-counted during the off period. The 7490 IC has a reset-to-9 feature which makes this possible. At the end of each gate (on) period, a reset pulse is developed to put the counter back to zero to be ready for the next count. This pulse also sets the 10-second divider to 9 so it only has to count one more second to begin a new gate.

A gate lamp on the front panel indicates when the gate is on. This is a useful feature to show that the gate is working properly, and for the longer gates, shows when a count is completed so the input signal can be switched or disconnected.

Transfer Pulse Generation

A transfer pulse is needed immediately after each gate is over to transfer the data from the six-digit counter to the latches. The inputs of the latches are permanently connected to the BCD outputs of the counter, so it is only necesary to feed a positive XFER pulse to the clock inputs of the 7475 latch IC's to accomplish the transfer.

The negative-going trailing edge of the gate is differentiated by capacity-coupling to a TTL gate input, thus developing a short pulse. Multiple gates are required to "fan-out" the pulse to drive the thirteen latch clock inputs. Each gate will drive up to ten standard TTL load units. Each 7474 clock input is two standard TTL loads, so thirteen clocks represents 26 loads, and three gates are necessary to drive them.

Reset Pulse Generation

The RESET pulse must come some time after the XFER pulse, but some time before the beginning of the next counting period (GATE). This is accomplished by adding the inverted GATE ($\overline{\text{GATE}}$) and the 10 Hz trigger in a NAND gate, then differentiating the output, as shown in Fig. 9.

Note that the XFER pulse occurs as the GATE switches down, and the RESET pulse occurs as the NAND signal switches down in the middle of the GATE off period 50 milliseconds later. The timing shown is for the 0.1-second gate, but pulse generation is the same for all gate lengths, with the RESET pulse occurring 50 ms after the XFER pulse in all cases.

Signal Pre-Amp

The signal pre-amp is a discrete transistor circuit swamped with heavy negative feedback to have a flat, controlled gain response from dc to better than 10 MHz. An input blocking capacitor causes a low-end rolloff down 6 dB at 5 Hz, and internal capacity of the transistors causes a high-end rolloff down 6 dB 20 MHz or above. The result is a reliable triggering sensitivity of 10 mV over the flat range, up to 20 mV at 5 Hz and 20 MHz.

Trigger/Pulse Generation (low frequency)

The low-frequency signals (below 20 MHz) are processed through a discrete Schmitt trigger squaring amplifier and then through a 9601 IC one-shot pulse generator. The maximum frequency of this circuit is limited by the toggle rate of the one-shot. At 20 MHz (period 50 nanoseconds) the 30 ns pulses from the one-shot are beginning to run together. The output of the O.S. is normally high, with 30 ns-wide negative pulses at every positive zero-crossing of the input signal. When MHz is selected, the O.S. gate is grounded, locking the output high and enabling the scaler output to be passed through the summing NAND gate.

Pre-Scaler (high frequency)

A 95H90 IC divide-by-ten prescaler is used to divide the signals from 5 MHz to 220+ MHz down to within the counter range. As the basic counter will count to better than 30 MHz, a typical 95H90 can go to 300 MHz, although the manufacturer only guarantees 220 MHz.

The input of the 95H90 is much more sensitive than the squaring amplifier used in the low frequency path, so the pre-amp provides usable sensitivity, even though it is rolling off with increasing frequency. Very light coupling to the pre-amp prevents overdriving the pre-scaler at low frequencies, but prevents the use of the pre-scaler below 5 MHz.

A simple one-transistor amplifier buffers the emitter-coupled-logic (ECL) levels used by the 95H90 to the TTL levels used by the rest of the counter.

The pre-scaler gate, grounded when MHz is selected, allows normal operation of the pre-scaler. When Hz or kHz are selected, the pre-scaler output is locked high enabling the one-shot output to be passed through the summing NAND gate.

Power Supply

The power supply used for the counter is quite similar to the one used in the clock unit, and described in detail previously. In this case I used displays that required a separate power transformer for the lamp supply and electronic power, but this could vary with the builder's display lamp choice.

As before, I used an IC regulator for the 5 volt IC power which is so cheap and simple that there is no other way to go, and unfiltered lamp power, but no batteries are used or needed.

RFI Considerations

As discussed earlier, digital circuitry generates considerable RFI, and equipment using it should be shielded and filtered as in TVI-proofing a transmitter.

CIRCUIT DETAILS

Counter/Latches/Decoders/Displays

Circuit connection considerations for the counters, decoders and displays are the same as given for the clock unit described previously, except for a straight decade counting scheme, as can be seen in Fig. 10. 7490 decade divider IC's U7 through U12 make up the six digits of the counter, with half of U6 being the remaining half digit (overflow "1"). Each is connected with the divide-by-

two (A) section ahead of the divide-by-five (BCD) section for BCD counting.

Gate 4 (pins 11, 12, 13) of quad NAND gate U1 controls the triggers for the counter and is the gate shown in Fig. 7. Gate 1 (pins 1, 2, 3) is the summing gate for triggers from the high and low frequency paths of the front end.

Gated triggers from Gate 4 drive the A Clock Pulse Input (CP 1) of the Units Counter U7. The A output drives the BCD Clock Pulse Input (CP 2), and the D output drives the CP 1 input of the Tens counter U8. Here BCD refers to the B, C, & D flip-flops making up the divide-by-five section, not the BCD counting code. In a like manner the signal progresses through the counter chain Tens through Hundred-Thousands digits. The D output of the last decade U12 drives the overflow counter, section 1 of dual D flip-flop U6, through the inverter 4 of hex inverter U5. This extra inversion is necessary because the 7474 Dual D flip-flops use a positive trigger instead of the negative trigger used by the 7490.

Reset and unused pin considerations were discussed previously. Unused inputs assume a logical "1" state, so the unused reset-to-nine inputs (pins 6 and 7) of the 7490's must be grounded.

The A, B, C and D outputs of the 7490 counters are connected respectively to the A, B, C and D inputs of the 7475 Quad Latches so that the four-bit BCD data from the counters is transferred directly to storage when the latch's two CP inputs are pulsed. The A, B, C and D outputs of the latches are then connected respectively to the A, B, C and D inputs of the decoders.

For testing the lamps in the display units, the LT inputs (pin 3) of all the decoders are grounded. Internal logic in the decoders generates a figure "8" which uses all display lamp segments.

The overflow "1" line is connected to the blanking input (pin 5) of the Hundred Thousand decoder U24, whose blanking output pin 4 is connected to the blanking input pin 5 of the next lower decoder U23 and so on down through U20. This accomplishes the leading zero blanking described earlier.

Overflow

The 7474 IC U6 contains both the overflow and latch flip-flops. The 7474 requires a positive trigger and a negative reset, both the opposite of the 7490, so those signals are inverted by sections 4 and 3 of 7404 IC U5. The D input of the overflow flip-flop (U6 pin 2) is permanently wired to a logic one (5 volts) so that a one will be stored for one or more outputs from the Hundred-Thousands divider. Then when the XFER pulse occurs, the overflow one is transferred to the latch portion of the 7474.

Because the 7474 does not have a current-sinking output like the decoders, a lamp-driver transistor Q5 must be used regardless of the type lamps used.

Time Base

The time base consists of circuitry which delivers a 10 Hz square wave to the Gate Control section. A selector switch determines whether this 10 Hz is derived from the external precision time base or internally from the power mains.

The external time base 10 Hz is connected to the counter unit through a 90-ohm (RG-62) coaxial cable, and appears as a 2-volt square wave on that cable. A line receiver, made up of a 100-ohm termination and a switching transistor Q4, converts this low impedance signal to standard TTL logic levels. A 1K resistor is used to limit base current to Q4.

A Schmitt trigger, made up of Q1, Q2 and Q3, squares the 60 Hz waveform from the power transformer and converts it to TTL logic levels. The 7492 IC U4 divide-by-six section then divides the 60 Hz down to 10 Hz.

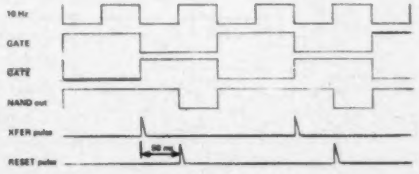

Fig. 9. Pulse timing diagram.

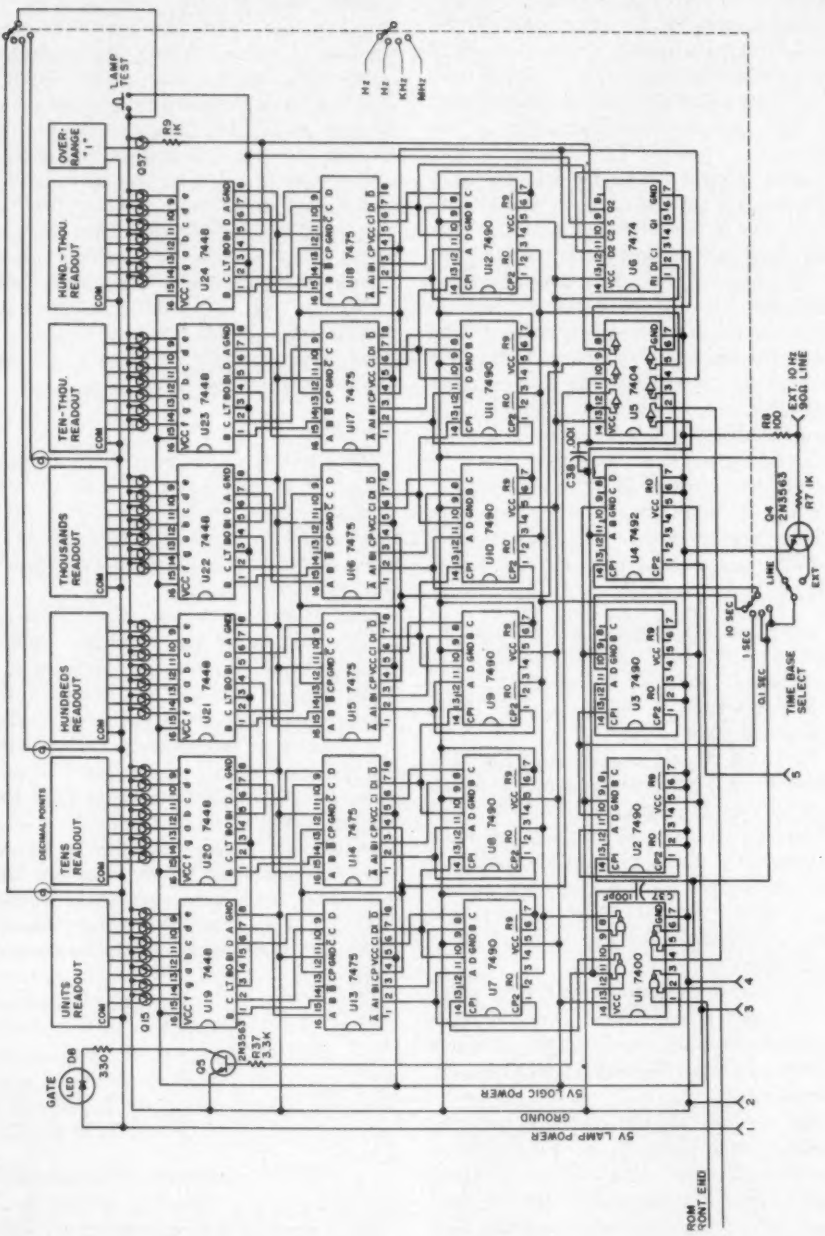

Fig. 10a. Schematic of the frequency counter. Note: C3–C26 are not shown. These are .01 disc ceramics connected directly from Vcc to ground at each IC.

Gate Generator

The gate is generated by the A (divide-by-two) section of 7492 U4. The CP 1 input for this flip-flop is selected by the Hz-kHz-MHz selector switch, and is either the 10 Hz time base signal, or that signal divided by ten or a hundred. The 10 Hz signal generates a gate that is on (logic one) for 0.1 second and off (logic zero) for 0.1 second alternately in the MHz and kHz modes.

In the Hz 1-second mode, the 7490 IC U2 is switched in to divide the 10 Hz to 1 Hz, and the gate is on for one second and off for one second. In the Hz (10-second) mode, the 1 Hz output of U2 is further divided to 0.1 Hz by 7490 IC U3. the RESET pulse from U1 pin 8 is connected to the reset-to-nine input (pin 7) of U3 to short-count this decade when the gate is off. At the end of each ten-second gate on period, the RESET pulse that clears the counter advances U3 to the count of 9 so that only one more count (one second) is required to start the next gate.

Pulse Generators

Inputs to a TTL gate, such as the 7400 or 7404, are emitters of NPN transistors. These must be grounded to cause current flow (about 1.5 mA) to create a logic zero input. An input can either be forced above +2V or left open to cause no current flow and a logic one input.

If a signal with a fast fall time is capacitively coupled to a TTL input, a current pulse is pulled from the emitter as the signal switches down, causing the inverting gate to output a short positive pulse as the capacitor charges. When the signal switches up, the gate input voltage is driven above the supply voltage, causing the emitter to zener, discharging the capacitor.

A 1000 pF capacitor couples the GATE signal to three sections of 7404 hex inverter U5, generating XFER pulses at the end of each gate. Three inverters are required to drive all the loads on the XFER lines, as explained earlier.

NAND gate 2 of U1 generates a down-switching signal 50 milliseconds after the XFER pulse as explained previously and in Timing Diagram Fig. 9. This is coupled to gate 3 of U1, used as an inverter, which generates the RESET pulse. The loads on the RESET line are lighter than those on the XFER lines, so only one gate is required to drive all loads.

Gate Lamp

In my prototype model I used a #47 pilot lamp, but this took a two-stage transistor driver and nearly 150 mA current from the supply. I have since tried the little light-emitting-diode (LED) circuit shown in the schematic and find it does the same job with only one transistor and 15 mA supply current.

Signal Pre-Amp

The schematic diagram for the counter front end, including pre-amp, squaring amp, one-shot and pre-scaler is shown in Fig. 11.

The pre-amplifier is basically a two-stage discrete transistor common-emitter circuit,

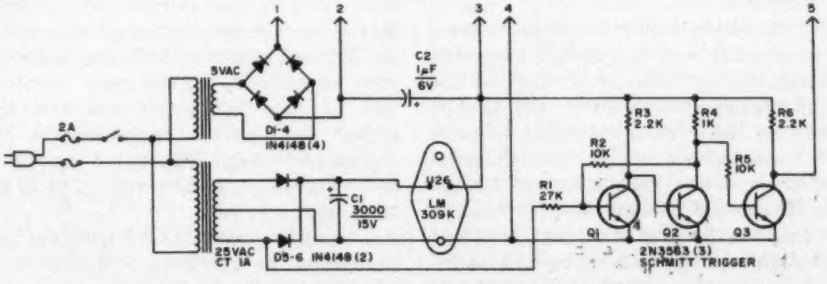

Fig. 10b. Counter power supply. Connections are made via the points numbered 1–5.

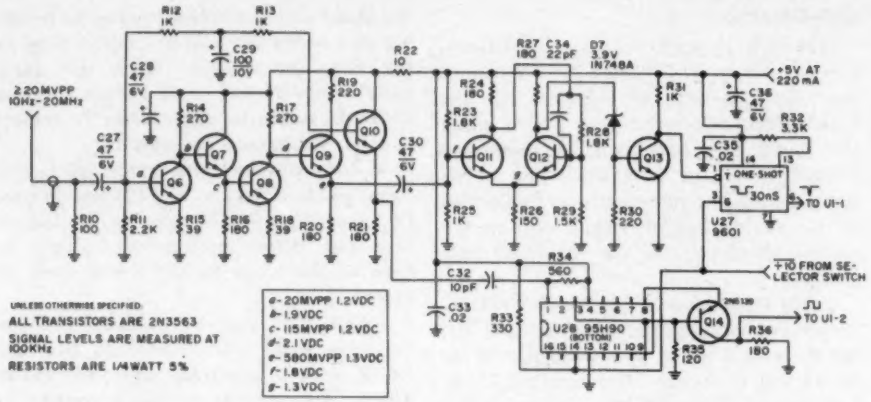

Fig. 11. Schematic of the front end of the counter containing the preamp and pre-scaler.

with emitter-follower buffers used for impedance-matching. Q6 and Q8 are the common-emitter gain stages. The 2N3563 transistors used have an Ft of 900 MHz, making them very good high frequency transistors, but even so at frequencies above 10 MHz their output impedance is so much higher than their input impedance that the emitter follower Q7 is required to match between stages. Emitter followers Q9 and Q10 are used to drive the squaring amp and prescaler, respectively.

Q6 and Q8 have unbypassed emitter resistors R15 and R18. This provides large negative feedback which keeps the amplifier's response flat over most of its useful frequency range.

R12, C29 and R13 form a negative feedback path for dc to stabilize the operating bias of the amplifier.

Squaring Amplifier

The squaring amplifier is a Schmitt trigger made up of Q11, Q12 and their associated circuits. In the absence of a signal, Q11 is biased slightly below cutoff and Q12 is turned on. The voltage divider R24, R28 and R29 holds the bias on Q12 slightly higher than on Q11. Signal voltages applied through C30 have no effect until they raise Q11's bias equal to Q12's; at that point Q11 turns on and the voltage drop across R24 lowers the bias on Q12 causing it to snap off. Subsequently, the signal voltage to Q11 must be lowered below the new Q12 bias point to transfer conduction back to Q12. About one volt of hysteresis is thus obtained.

C34 is used to speed up the switching action, extending the frequency response to 20 MHz.

Q13 is used as a level shifter to couple the Vcc-referenced output of the squaring amplifier to the ground-referenced input of the one-shot gate.

One-Shot Pulse Generator

The pulse generator is a 9601 IC U27 connected for the shortest possible pulse width, allowing operation to 20 MHz. R32 sets this pulse width.

Prescaler-Buffer

A Fairchild 95H90 IC U28 is used as the prescaler. The input has an internal pull-down resistor, so an external pull-up resistor R34 is used to bias the input to just below the point of triggering. 560 ohms was about right for my unit, but this might vary from unit to unit. Setting this bias level high enough for sensitive triggering but low enough to be stable is critical. I was able to achieve reliable triggering with about 30 mV of signal.

The buffer transistor Q14 shifts the logic levels from the ECL levels of the 95H90 to TTL levels for the counter gates.

. . .K5DUS

Andy Becker W0NVM
232 New Ballwin Rd.
Ballwin MO 63011

ANOTHER USE FOR 400 CYCLE TRANSFORMERS

Any amateur who has converted surplus electronic equipment has at some time or other ended up with a 400 cycle power transformer which became a paperweight, bookend, or in most instances a gift to the trash collector.

These transformers are not as useless as they may at first appear. In the June 1968 issue of 73 magazine W4UBH published an article on putting them to work in audio circuits. Another use for them that I have not seen written up anywhere is low voltage power supplies. With more and more amateurs experimenting with transistors and integrated circuits, these transformers make excellent low voltage power supplies by hooking them up backwards. That is, connect the 115V to the secondary winding and take the low voltage from the primary winding.

Figure 1 shows the original power supply as it was used on 400 cycle. Figure 2 shows the hookup for use as a low voltage supply from 60 cycles. With the hookup shown in Fig. 2, the voltage between terminals 1 and 2 is 27V with no load. With a load that draws 520 mA, the voltage drops to 23V. The original secondary ratings was 240V each side of center tap at 45 mA. The original ratings give some idea of what voltage and current can be expected in the reverse hookup. At the present time I have plans to make an adjustable power supply using this reverse connected 400 cycle transformer. I will not go into the filtering and regulating circuits; that has been covered in the past issues of 73 and other magazines. One word of caution – don't use a transformer that has any of the original secondary windings connected to the case of the transformer. This could give you a fatal shock should you come in contact with the transformer case and ground.

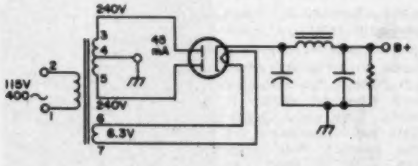

Fig. 1. Original circuit.

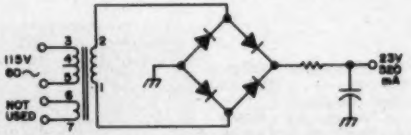

Fig. 2. Reverse connected for low voltage power supply.

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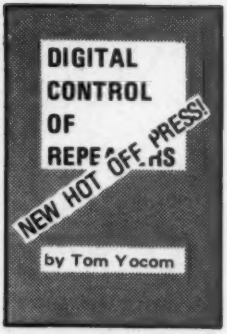

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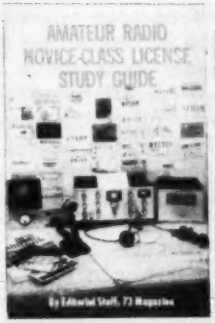

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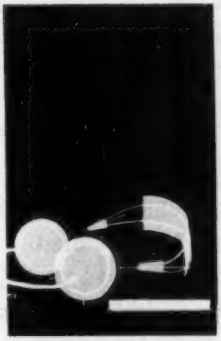

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BANDPASS FILTER DESIGN

With the advent of the "modern network theory" method of filter design, this involved phase of electronic engineering has been greatly simplified. Now almost any engineer can design filters to suit his needs with a minimum of time and effort. I have gone a step further and simplified the procedure even more. The result is a specialized filter type which is ideally suited to pulse inputs (mark-space) and which uses the infamous 88 mH toiroidal inductor which is widely available on the surplus market. Information is given, however, for those who wish to use other inductors (this is necesary when a particular input impedance is specified and one does not wish to link-couple to the input inductor). The design is based on the center frequency, bandwidth, skirt requirements, and available inductor "Q."

About the Filter

The filters I describe are those whose response is best suited to on-off (pulse) inputs. They are characterized by a linear phase delay function across the passband. This has the effect of distorting the pulse shape (leading and trailing edge round-off) and length (minimum ringing) as little as possible for a given bandwidth. The shape of their passband amplitude response, however, is not flat; it is rounded and has no definite 'cut-off" point. This is of little consequence because the signals (mark and space) can be tuned to appear at the center of the filter passbands at the receiver (assuming correct shift is used). These linear phase filters have been used in commercial carrier systems for a long time, on narrow band channels, because of these characteristics.

The network configuration of these filters should be the "high side capacitively coupled resonator" type. The reason for this choice is that it is the only configuration which allows the designer to use the same value of inductance throughout. Since in most cases the RTTY experimenter will have an abundance of 88 mH toroids, this proves to be the only practical choice.

Assuming you will choose to use the 88 mH toroids and therefore tolerate any reasonable impedance for the filter, there are several ways to design the filter input. If the impedance happens to come out at a convenient level for the load of a preceding amplifier, the first resonator is returned not to ground (as are all others) but to B+. The high side of the input is connected to the plate of the tube. A word of caution here: The dc component of the plate signal will tend to alter the inductance of the toroid slightly, and this type of filter will have to be tuned while being driven by and driving the circuits in which it is to go. Another method is to determine the required impedance and the turns ratio which will give same when a link is wound on the first (input) coil. The method used to find the natural input impedance of the filter from other parameters will be shown.

The output of load impedance for all cases of the filters described here is, ideally, infinite. Practically, it is very high making it quite suitable to feed the grid of a following amplifier stage. If it is necessary to feed a low or medium impedance with these filters, a cathode follower can be designed which will have the correct output impedance and very high input impedance. Data for this will be found in *Reference Data for Radio Engineers*, ITT, fourth edition.

The ITT handbook is a necessary item when using this design procedure because it contains the basic information for the design parameters. Reference to page and figure numbers are from the handbook unless otherwise specified.

This procedure and configuration holds *only* for the narrow bandwidth case. The

design rests on the assumption that the coupling capacitors' reactance remains constant throughout the passband. It can be seen that this will be approximated only in narrow band filters. There is little call for filters that are very wide in a RTTY demodulator, so little difficulty will be experienced in this area.

In summation, these filters will be narrow-band, capacitvely coupled resonators, linear phase response, loaded only at the input (singly loaded).

Definition of Design Parameters

The first step in designing the filter is to define the parameters and characteristics which the designer wishes his filter to possess. The characteristics of the elements to be used must also be stated.

1. Center frequency = f_O – the frequency to be passed with least attenuation.
2. Bandwidth = BW – the range of frequencies passed with 3 dB or less attenuation.
3. Number of sections desired in the filter. Five sections are suggested, because with less, the skirts are not steep enough for use as closely spaced channel frequencies without some cross-channel interference. Seven sections are rather elaborate, but there may be applications where the additional skirt steepness is necessary.
4. Circuit "Q" (QC) = f_O/BW.
5. Available element 'Q" = QB. For the 88 mH toroids, since the dc resistance is on the order of 8 Ω, the QB is given by QB = $(2\pi)(f_O)(0.088)/(8)$, or, more simply, $(0.691)(f_O)$.
6. QP = (QB)/(QC).

Now that the basic parameters have been defined, the design can begin. On pages 203 and 204 in the ITT Handbook, find the attentuation curves for the filter with the number of sections that you have chosen to use. Be sure the attenuation meets your needs. On pages 223 and 227 find the design curves for the three section and five section filters. Figure 37 (page 227) shows the general configuration of the filter.

Actual Design Procedure

Using the graphs in the handbook applying to the number of sections chosen, we proceed:

1. Chose the ordinate (horizontal axis) equal to "QP."
2. From the abcissa (vertical axis) read off all "k" values and that of 'q1."
3. A low pass prototype will now be computed (p. 164, Fig. 1c). The "P" values so derived will be the elements of a pi-section low pass filter with a cutoff at 1 rad./sec. and an input impedance of 1Ω.

The formulas are:

P1 = q1

P2 = 1/((k12)(k12)(P1))

P3 = 1/((k23)(k23)(P2))

etc.

4. The prototype will now be scaled to a cutoff frequency consistent with the bandwidth chosen. This requires that all element values be multiplied by "QC." They will be called the "A" values:

A1 = (P1)(QC)

A2 = (P2)(QC)

etc.

5. The normalized values for the resonator capacitors and the input impedance is now found. The resonator capacitors are set equal to A1. Since the filter is to resonate at 1 rad./sec., the inductance is given by 1/A1. These are "L" and "C'." Since we will use only the 88 mH inductors, the input impedance must be chosen so that the final value of the inductance is 88 mH. It is given by:

Z = $(2\pi)(f_O)(0.088)/L'$

6. A scaling factor will now be found which will render the final capacitance values of the filter from those "prime" values given above and further on in the procedure:

S = $1/((2\pi)(f_O)(Z))$

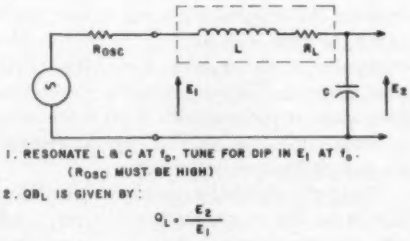

Fig. 1. Determination of QL.

To check your work, find the final value of C (C = (C')(S)). Check your result for resonance with 88 mH at the center frequency by means of a reactance chart or the resonance formula.

7. The coupling capacitors are now determined. The designation "C12" will mean the coupling capacitor between sections 1 and 2 of the filter. (See Fig. 37, p. 227).

$$C12 = \sqrt{\frac{(C')\ (C')}{(A1)\ (A2)}}$$

$$C23 = \sqrt{\frac{(C')\ (C')}{(A2)\ (A3)}}$$

8. The normalized coupling capacitors should now be multiplied by "S" to get the final values.

Final Notes

The design is now complete. There are several things to watch out for, however. The "QP" value used on the horizontal axis of the design graph should be taken about 5% low to account for core losses, etc. Further, if the design frequency gets higher than about 3 kHz, the core losses in the 88 mH toroid begin to rise and the "QB" drops off. This should be taken into account. The best way to get the "QB" of the coil at the design frequency is to measure it directly. The figure shows how this can easily be done with a good VTVM and an audio generator. This measured "QB" should then be used to compute "QP" and the design will be exact. Where the "QB" is in question, this procedure must be employed to obtain an exact "QP."

Tuning the Filter

Tuning these filters is quite simple. The most important requisite is an accurate frequency source at the center frequency. This can be set by Lissajous figures, frequency counters, etc. Each resonator in turn, from input to output, is fed through a high resistance from the generator. All other coils in the filter are shorted out. The resonator which is active is then tuned for a peak at the center frequency. This procedure is repeated for each resonator, in turn, from input to output. The easiest method for tuning the resonators is to start with a C value about 10% below the design value. The VTVM is then hooked across the resonator and the generator set at the center frequency *accurately*. A capacitance decade box is connected across the resonator and the capacitance needed to peak the VTVM at the center frequency is simply dialed up. The decade is then removed and a fixed capacitor (or combination of capacitors giving the exact decade reading) is placed across the inductor. The resonator is then checked again for a peak exactly at the center frequency. There is no reason that accuracy to 1 Hertz cannot be achieved by calibrating the generator with the 60 Hz line frequency and reference frequencies of WWV, using Lissajous patterns. Of course, use of a frequency counter is most convenient.

Mechanical Details

Care should be taken in the final assembly of these units. The filter should be tuned in a "breadboard' configuration, but connected to the circuit in which it will be used. When the filter is tuned, the individual L-C pairs (resonators) should be numbered to keep them in the proper sequence. This is important because the values of the coupling capacitors on either side affect the resonance point of each L-C circuit. These resonators cannot be mixed up or the filter will be badly out of tune.

The capacitors should be 5% units, MYLAR, for stability. Other types of capacitors (paper, disc ceramic, etc.) should not be used if a high quality, stable unit is desired.

Wrap the input toroid if a link is to be wound upon it. It should be wrapped with mylar tape to avoid the possibility of scuffing the insulation on either the main winding or the link when the link is wound. Winding the link is an easy procedure if a shuttle is employed. This can be any type of rod or stick with notches cut in either end. The wire is then wound on the shuttle end-to-end (around the ends) until the required amount for the link is on the shuttle. The shuttle is passed through the center and around the outside until the required number of turns are completed. The wire is dispensed from the shuttle as needed. Use a wire size sufficient to carry the plate current.

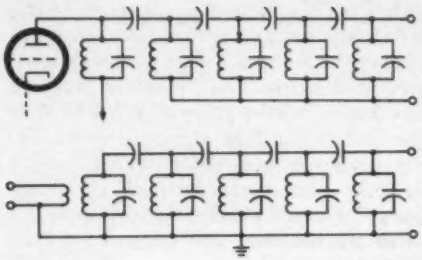

Fig. 2. Typical 5-section filters.

Take care on final assembly that the toroids are not completely surrounded by metal. This is equivalent to a shorted turn, and the filter will not operate.

The inductors may be placed one on top of the other without fear of mutual coupling, if a cardboard disc the diameter of the toroid is placed between each coil.

Parts layout for the filter is not critical if the above rules are heeded. I managed to pack two 5-section filters into a 2¾ x 3¾ x 2¼ in. deep drawn can. The filters were assembled in a vertical fashion and wired without terminals. They were placed inside the can, and the leads brought out. The can was then filled with RTV-11 room temperature vulcanizing rubber.

Epoxy should be avoided because in quantities sufficient to fill the aforementioned can, the temperature rise caused by curing will change the element values and the result is a hard block full of worthless junk!

A form-fitting top was punched for an octal plug, which was installed and sealed with a bead of epoxy. The top was then fitted to the can, the leads soldered to the pins, and the top soldered to form a hermetic seal. This type of construction makes the filter well protected against damage, moisture, and other possible enemies.

Summary

The ability to design his own filter is a great asset to the RTTY man. He can tailor the channel bandwidth to his own needs; wide for net or round-table use or for the guy who hasn't taken the time to set his shift accurately; narrow (to 66 Hz) for digging into the noise for weak signals and for crystal controlled auto-start monitoring. Narrow filters, while giving excellent signal to noise ratio, have several disadvantages. Tuning to the center of a set of 85 Hz filter is critical and difficult, especially if the TU has no tuning indicator (i.e., a scope). Also, using the narrow filters at high frequencies requires a greater QC, resulting in more ring. There is a point, yet to be determined, where the gain in S/N is overpowered by the ringing tendency on noise. Choice of shift, center frequency, channel bandwidth, and channel skirt selectivity are powerful tools for the RTTY enthusiast interested in improving his receiving copy. The ultimate, short of mixing in the channels and using identical channel filters, is to have several sets of filters giving selectable shift and bandwidth capability. A great improvement in copy is obtainable (approximately 6 dB better S/N) by going to 85 Hz channel bandwidth from the usual shallow-skirted, 300 Hz single-toroid filters found in many TU's. When designing filter pairs for two-tone of FM use, the area under the response curve of each of the filters should be made as nearly equal as possible. This will ensure equal noise energy in each channel and provide optimum cancellation of noise.

To determine the response curve of a filter design without actually building it, refer to the response curves on pages 203 and 204 of the handbook. Knowing that the two frequencies of equal attenuation give the center frequency as their *geometrical* mean, one can draw the response curves scaled logarithmically from those given. The bandwidths of the filters of a pair can be adjusted around optimum to give equal areas under the response curves. The area should be taken with a bottom limit of −60 dB.

The design lists a resistor to load the input resonator. In practice, this is adequately accomplished by loading the input slightly heavier than design.

. . .WB6NWQ

References

1. ***Reference Data for Radio Engineers*** IT&T, Fourth Edition.
2. ***Simplified Modern Filter Design,*** Philip R. Geffe (Rider, 1963).
3. ***Of RTTY — and Filters,*** Frank VanBrunt W3TUZ, 73 Nov. 1962.

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Lists more than 1700 items—pliers, tweezers, wire strippers, vacuum systems, relay tools, optical equipment, tool kits and cases. Also includes four pages of useful "Tool Tips" to aid in tool selection.

JENSEN TOOL & ALLOYS
4117 N. 44th Street Phoenix, Arizona

.....Looking West continued.

of the best all around coverage of any machine out here, and TDD is starting to develop into another SUR as far as getting late night QSO's are concerned. TDD is located atop Mt. Wilson at about 6700 feet msl. Needless to say, it's coverage is near fantastic. I myself have heard mobiles in San Diego quiet the machine.

Now I don't mean to slight any of the other repeaters in this area. It's only that I have not had the opportunity to use most of them as yet. So that's it for now... please let me know what you think of Looking West. Feedback both positive and negative is necessary if Looking West is to continue.

WA2HVK/6

Editor's note: Bill is an old, old friend of 73, and we're glad to hear from him. We've been trying for a couple of years to get someone to provide FM news from those west of the San Andreas Fault before it breaks off and drifts up to Alaska, so we welcome Bill and his effort. If you like this material, let us know and it'll continue.

Joe Kasser G3ZCZ/W3
1701 East-West Highway, Apt. 205
Silver Spring MD 20910

This month we look at the scene down under in Australia and New Zealand. For local use, there are plenty of VHF repeaters covering the big cities. They even have a class of license similar to the American Technician class, so reciprocal permits are available to all. They use nationally agreed channels just like the U.S.

The following frequencies are in use in Australia:

FM SIMPLEX

145.854
146.000
146.146

FM REPEATERS

Input	Output
146.100	145.600
146.400	145.900

Deviation ±15 kHz

The following frequencies are in use in New Zealand:

FM SIMPLEX

Every 50 kHz between 145.80 and 146.20

FM REPEATERS

Channel	Input	Output
A	146.30	145.60
B	146.35	145.65
C	146.40	145.70
D	146.45	145.75

Deviation ±12 kHz

I don't have any very recent information on the locations of the Australian repeaters, but the following list covers New Zealand:

CHANNEL	LOCATION
C	North Auckland
B	Whangarei
A	Auckland
B	Waikato
C	Eastern Bay of Plenty
A	Northern Hawkes Bay/ Gisborne
C	Southern Hawkes Bay
D	Taupo
C	Egmont
B	Wairarapa
A	Hutt Valley
D	Wellington
A	Farewell Spit
B	Takaka
A	Nelson
B	Westport
C	Greymouth
B	Hokitika
A	Christchurch
B	Timaru
A	Dunedin
C	Central Otago
B	Invercargill

This list is reprinted from the 1972 New Zealand Call Book.

All repeaters are carrier access in both countries. Thus for anyone visiting those places a useful simplex channel would be 146.000 MHz.

If you do not monitor VHF but would like to work or monitor the HF bands, remember that the 40 and 80 meter bands will be smaller than in the USA and that both countries have an 11 meter band. You may even get some QSO's on a CB rig.

For the most up-to-date information on reciprocal licenses, write to the national societies. They will also be able to give you club addresses and phone numbers in the places you hope to visit.

Their addresses are as follows:

New Zealand Association of Radio Transmitters Inc. (NZART)
Box 1459
Christchurch
New Zealand
Telephone: Christchurch 64556

Wireless Institute of Australia
Try writing to the Victorian Division. They publish the magazine, and should have the most up-to-date information.
Victorian Division WIA.
478 Victoria Parade
East Melbourne
Victoria, 3002
Australia
Telephone: 413535

G3ZCZ/W3

FCC NEWS

The following was released by the FCC concerning its action on repeater petitions that were filed against Docket 18803, Rules and Regulations governing repeater installations. While the decision was reported in brief last month (p. 24), here is the actual Opinion and Order *that was adopted by the FCC on December 20, 1972.*

In the Matter of Amendment of Part 97 of the Commission's Rules concerning the licensing and operation of Repeater stations in the Amateur Radio Service –

MEMORANDUM OPINION AND ORDER, FCC 72-1184
89733

1. The Commission has under consideration its Report and Order (FCC 72-757) released September 8, 1972, in the above-entitled proceeding, the petitions for reconsideration, and/or stay, and other petitions requesting changes to the rules adopted in the Report and Order, filed by The Northern Berkshire Amateur Radio Club, Inc.; Wayne Green (2 petitions)[1] 73 Magazine for Radio Amateurs (4 petitions)[1]; The Texas VHF-FM Society; The Fort Worth Chapter of the Texas VHF-FM Society; Fort Worth-Tarrant County Office of Civil Defense; Fort Worth-Tarrant County RACES; North Central Texas Six-Meter Repeater Association; Repeater Committee of the Arlington (Texas) Radio Club; VHF Advisory Committee of Montana; The Engineers Repeater Group; American Radio Relay League (ARRL); Naval Communications Command; Ben F. Meyers, Jr.;

Michael F. Troy, et al; James L. Hudson; Roy L. Albright; Robert S. Levy; P. Miair; H. L. Watkins; and the Northeast Repeater Association. In addition to these petitions, which were timely filed, there were a number of informal letters and petitions received by the Commission after the time for filing petitions for reconsideration had expired,[2] both in support and in opposition to the amendments to Part 97 as adopted in the Report and Order.

2. Briefly summarized, the petitioners request reconsideration of the Report and Order, and seek either additions, deletions, modifications or a combination of these to the amendments adopted therein, or a stay in the date the amendments become effective. The petition of the Northeast Repeater Association, requests neither a petition for reconsideration nor a petition for review, but merely requests an extension of 30 days in which to file a petition for reconsideration.[3]

3. The majority of the petitions address the matter of supervisory control of a repeater station, and the nature of the responsibility of a repeater station control operator. Indeed, from the remarks of the petitioners, it appears some misunderstanding existed about the need for a control operator under the rules in force prior to the adoption of Report and Order 18803. Then, as now, when in operation every amateur radio station must have a control operator at an authorized control point. Unattended operation of an amateur radio station is not provided for in the rules. The petition of the Fort Worth-Tarrant County Office of Civil Defense, requests amended rules to permit repeater stations to operate without a control operator on duty. Petitioner Albright requests additional rules for special unattended repeater stations equipped for tone-coded access on the input frequency. Petitioner Hudson requests another class of repeater station be established in order to accomplish the same purpose. The Engineers Repeater Group petition requests tone-coded access be a requirement for all repeater stations, and the user-operator transmitting the access signal be made responsible for the proper use of the repeater station. The Texas VHF-FM Society petition requests tone-coded access be permitted as an alternative to continuous monitoring.

4. Seven petitioners request that the rules place the burden for proper use of repeater station only upon the user station operator transmitting on the input frequency of the repeater station. They further request that the rules limit the responsibility of a repeater station control operator to properly maintaining the technical operation of the station. Of these petitions, several would require the control operator to have the means to remove the repeater station from service upon notification that the station was being used improperly. Although not specified, the notification would presumably come from user operators. Petitions would allow 15 minutes or more after the notification for the control operator to terminate the repeater station transmissions.

5. Seven petitions request rules for repeater stations having wide regional coverage. The petitions request deletions of the provisions of §97.89(c) and §97.69(c) which effectively limit the service area of repeater stations to intra-community coverage. Some of these also request an increase in the maximum authorized power limits for repeater stations, in one or more amateur frequency bands.

6. The Fort Worth-Tarrant County Office of Civil Defense petition requests, in effect, that repeater stations in RACES be permitted to operate in the entire 220–225 MHz frequency band. Petitioner Harris requests the same provisions and would also allow RACES repeater stations operating on frequency bands 50.35–50.75 MHz and 145.17–145.71 MHz to also be used for non-RACES purposes. A 73 Magazine for Radio Amateurs petition requests the entire frequency band 220–225 MHz, and an additional 2 MHz from 440 to 442 MHz, also be made available for repeater station operation. Additionally, petitioner 73 Magazine, requests rules permitting crossbanding of repeater stations.

7. The Northern Berkshire Amateur Radio Club petition requests the deletion of the requirement for certain of the showings specified in §97.41 for repeater stations. The Repeater Committee of the Arlington Radio Club petition requests additional rules providing for temporary, experimental repeater stations.

8. The information submitted in the petitions adds nothing new to that available and considered by the Commission in adopting the Report and Order. While the Texas VHF-FM Society petition puts forth the argument that amateurs have demonstrated the means to generate stable, distortion-free, audio tones required for accurately coding and decoding control signals, through the use of a recently available, inexpensive, hybrid integrated circuit, tone stability alone was not a major consideration in the decision to confine the use of such signals on a repeater station input frequency to secondary control purposes only.

9. Operation of a repeater station in the Amateur Radio Service can present unique problems not comparable to other radio services such as Land Mobile or Citizens Class A, where control operators are not required at repeater stations. For instance, specific frequencies are not assigned to amateur radio stations, as they are in other radio services. An amateur radio station operating frequency must be selected by the control operator. Good amateur practice requires that he monitor his selected frequency prior to transmitting, in order to insure that the transmission will not interfere with radiocommunication already in progress on that frequency. Repeater stations are no more exempt from this requirement than are any other type of amateur radio station. Indeed, with over 90% of the licensed amateurs in the Country alone having access to all of the frequencies where repeater stations are permitted to operate, supervisory control is very necessary. Moreover, these frequencies are not limited to voice operation. All of the types of emissions authorized for amateurs may be used on most of the frequencies where repeater stations are also permitted to operate.

10. Good amateur practice also requires the control operator of a repeater station to monitor the input receiving frequency prior to activating the repeater transmitter. A repeater station, as with any amateur station, may not retransmit signals not intended for retransmission. Again supervisory control is necessary since there could be radiocommunication already in progress on the input frequency not intended for retransmission. Also, if a repeater station retransmitted a simplex radiocommunication between stations on the input frequency, it would be violating the rules prohibiting one-way transmissions.

11. Several petitioners recognize these problems and propose to overcome them through a tone-access system. Users would activate the repeater station by transmitting a certain combination of tones on the repeater station input communication frequency channel. Such a technique is inadequate to provide supervisory control over a remote station. It will not prevent the activation of the station by unauthorized persons, nor will it assure that the control operator can deactivate the station where there are interfering stations on the same input frequency channel. Controlling an amateur radio station by radio remote control with a control link that uses a widely-known frequency, such as the input communication channel of a repeater station, is not good amateur practice. The use of

widely-known audio tones, such as those used in public telephone dialing systems, for remotely controlling an amateur radio station, is also not good amateur practice. A basic principle of radio control is that there be a reasonable probability the remote station will not be activated by unauthorized persons, and the control operator can indeed effect supervisory control of the station from the remote control point just as well as if the control point was located at the station.

12. We believe the ingenuity of amateurs can eventually develop the techniques, technical and operational, that will permit the adoption of rules for automatically controlled repeater stations. It is conceivable that automatic and reliable means can be developed that will perform all of the supervisory functions of a repeater station control operator under certain specific conditions. The Commission urged knowledgable persons to submit information on this approach. Several amateurs have already responded and although their ideas show promise, it is clear that provisions for automatic control are not warranted at this time.

13. The ARRL petition requests the effective date of the new and amended rules relating primarily to repeater stations be stayed until February 19, 1973. The Levy petition requests the rules be implemented after a minimum of ninety days. One of the Green petitions requests a delay of one year in the effective date of the amendments. The Troy petition would stay and put aside selected portions of the new rules. Inasmuch as the policy established for transition to the new rules announced in a Public Notice (90785) dated October 6, 1972, does provide a reasonable time for existing stations affected by the new rules to make the appropriate modification necessary for compliance, for the most part the objectives of the petitioners are already achieved. For instance, a station operating as a repeater station, and/or one authorized for remote control, whose license was granted as a result of an application filed prior to October 17, 1972, the effective date of the new rules, should comply with the new rules to the extent possible after that date, but must fully comply by no later than June 30, 1973. In view of the time and effort already expended in studies, evaluations and discussions in this matter, there should not be any further delay, with consequent postponement of the substantial public benefits the new rules promise.

14. The petition by the Naval Communications Command would delete military recreation stations from the types of amateur radio stations prohibited from portable or mobile operation by §97.95(a)(1). Petitioner cites three examples of portable operation by military recreation stations; K4NAA at the Armed Forces Communications and Electronics Association Annual Convention; Navy or Marine Corps sponsored military recreation /MARS station exhibit at the Southern Nevada Amateur Radio Club, Inc., Annual Convention; and the field day and emergency communications provided by K3USN. Since non-amateurs may be the license trustee of a military recreation station, they are not required to be familiar with our rules. These stations are principally intended for the recreational use of amateur radio operators serving in the Armed Forces, and the few instances where portable or mobile operation of a military recreation station is warranted can be best handled on a case-by-case basis.

15. After reconsideration of all factors raised in the several petitions, we conclude that the amendments to the Amateur Radio Service Rules as adopted by the Report and Order, FCC 72-757, on August 29, 1972, in docket 18803 are reasonable and in the public interest. Therefore, in view of the foregoing, IT IS ORDERED, that the petitions for reconsideration and/or stay listed in paragraph 1 ARE DENIED and that the amendments to

SBE "CRUNCHER"

turns mild mannered 2 meter mobile FM transceivers into 70-90 watt roaring tigers!

SB-1PA, Class C amplifier, connects between FM transceiver and antenna and to car battery — **boosts output power approximately 10 times** (i.e., 7W in, 70W out, etc.) And broad band —covers 143-149 MHz.

Small — less than 1/10 cu/ft, — rugged cast housing readily mounted in car . Built-in antenna relay operates from rectified RF. All solid state using highest commercial quality CTC transistors — not surplus culls. Long-life — minimum drain.

SEND FOR DETAILED BROCHURE

SBE

LINEAR SYSTEMS, INC. 220 Airport Boulevard, Watsonville, CA 95076

During Mr. Inoue's vist to 73 last december he became "one of the gang" as he pitched right in and helped repair the WA1KGO Repeater atop Pack Monadnock Mountain.

the Amateur Radio Service Rules, Part 97 adopted on August 29, 1972, ARE AFFIRMED

Federal Communications Commission
Ben F. Waple
Secretary

1. One of the Wayne Green petitions, and the four 73 Magazine petitions were not petitions for reconsideration and/or stay. Since they do request amendments to the rules adopted in the Report and Order, they are included in this proceeding.

2. Section 405 of the Communications Act of 1934, as amended, requires petitions for reconsideration to be filed within 30 days from the date which public notice is given of the order, decision, report, or action complained of. Among the late filed petitions were those filed on behalf of the Interstate Repeater Society, the Amateur Radio Caravan Club of New Mexico, and the Trenton Radio Club. The Commission has no authority to extend the time during which petitions for reconsideration may be filed.

DAYTON

The 22nd Annual Dayton Hamvention will be held Saturday, April 28, 1973, at the Dayton Hara Arena. Technical forums, exhibits, flea market and 450 MHz transmitter hunt. For information write: Dayton Hamvention, Box 44, Dayton OH 45401.

BIRMINGHAMFEST

The BirmingHamfest Amateur Radio Convention will be held on May 5–6, 1973, at the Alabama State Fairgrounds Exhibition Hall in Birmingham AL. This event is sponsored by the Birmingham Amateur Radio Club, John A. Outland, WB4PJU, President. Those wishing to attend or exhibit can get information by writing to P.O. Box 603, Birmingham AL 35201.

MIDLAND SWAPFEST

The Midland Amateur Radio Club, Midland, Texas, will hold their annual Saint Patrick's Day Swapfest on Sunday, March 18, 1973. The Swapfest will be preceded by the usual Social Events the afternoon and evening of March 17th.

COLUMBUS HAMFEST

The Columbus Amateur Radio Club, Inc., of Columbus, Georgia, will hold the fifteenth annual hamfest here at the Fine Arts Building, behind the Municipal Auditorium, at the Fairgrounds on March 25, 1973. For further information, write to J. T. Laney K4VGI, 1905 Iris Drive, Columbus GA 31906.

BALTIMORE HAMBOREE

The Greater Baltimore Hamboree will be held at Calvert Hall College, Putty Hill and Goucher Boulevard, Towson, Maryland (one mile south of Exit 28 of Beltway-Interate 695), on Sunday, April 8, 1973 at 10 A.M. Food service, flea market, prizes. Registration: $2.00 NO table or percentage charges. INFO: Joe Lochte, 5400 Roland Ave., Baltimore MD 21210.

MUSKEGON HAMFEST

The 1973 ARRL Great Lakes Division Convention-Hamfest will be held in Muskegon, Michigan on March 23–24. Ham-Hospitality will be offered at the Ramada Inn on Friday evening the 23rd. Saturday, starting at 8:00 AM, technical sessions, swap & shop, commercial exhibitions and net meetings will be held at Muskegon Community College. More fun at the Ramada Inn that night! Tickets are $2.25. Reservations and info may be had by contacting Muskegon Area ARC, PO Box 691, Muskegon MI 49443 (see their ad on page 105). If you attend you will also be able to meet the gang from 73 . . . we'll be there!

TRI-COUNTY SWAPFEST

The Tri-County ARC Midwinter Swapfest will be held March 11, 9 A.M. to 5 P.M. at the National Guard Armory, Whitewater WI. $1. advance, $1.50 at the door (additional $1. reserves one display table). Advance tickets eligible for special prize. Talk-in on .94. Refreshments, free parking, everything indoors. For tickets and details, contact Dan Servais, WA9AJW, RR4 Box 309AA, Elkhorn WI 53121. Tel. 414-723-2227. S.A.S.E.

FORT WALTON BEACH, FLORIDA SWAPFEST

The Playground Amateur Radio Club in Fort Walton Beach, Florida, announced the 3rd Annual North Florida Swapfest, to be held on March 25, 2973, from 8 a.m. to 4 p.m. at the Community Center located on Highway 98. Talk in on 146.94, 34/76, and 3957 kHz. Tickets and details are available from the Club, P.O. Box 873, Fort Walton Beach FL 32548.

ROCK RIVER HAMFEST

The 7th annual Rock River Radio Club Hamfest will be held on Sunday, April 8, 1973 at the Lee County 4-H Center in Amboy IL. Advance ticket price is $1.50 and gate price is $2.00. Prizes – free coffee and donuts from 9–10 a.m. – indoor facilities. Talk-in will be on .94. Note: Absolutely no fire arms permitted!! Tickets are available from Carl Karlson W9ECF, Box 99, Nachusa IL 61057.

TOLEDO AUCTION

The Toledo Mobile Radio Association's 18th Annual Amateur Radio Auction is to be held on Sunday, March 4, 1973, at Lucas County Recreation Center, Maumee, Ohio. Contact Barry C. Leeper WB8EAV, Raffle Committee, 1811 Wellesley Drive, Toledo OH 43606 for further details.

LAFAYETTE ARC BANQUET

The Lafayette Amateur Radio Club, Inc., will hold the Annual LARC Banquet on Saturday, March 10, 1973, at 7:30 PM at the American Legion Home, Surry Street, Lafayette, Louisiana. Trophies for the LA QSO Party, the famous "E" awards, and the annual "Cajun Award" will be presented. The food will be a "Cajun's Delight" prepared by Marshal Dallas Broussard. Happy hour will begin at 6:30 PM. Tickets are $7.00. LARC Banquet 1973, P.O. Box 345, New Iberia LA 70560. Talk in on 94/94.

FLORIDA QSO PARTY

FLORIDA SKIP, the all Florida Amateur Radio Publication, is happy to announce the 9th annual FLORIDA QSO PARTY to be held April 7th and 8th, 1973. All amateurs are invited to participate. Florida amateurs are urged to work as many out-of-state stations as possible as well as those within the state. Contest periods: Sat., 1500–2000; Sun. 0000–0500, 1400–2359. All times GMT. Exchange: Florida stations: RST and county. Non-Florida: RST and state, province or country. Trophies will be awarded to high scoring stations. Contact FLORIDA SKIP, Contest Chairman, P.O. Box 501, Miami Springs FL 33166 for further information.

1973 IARC PROPAGATION RESEARCH CONTEST

The object of this contest is work as many CPR zones as possible. Phone dates 0001 GMT Mar 24 to 2400 GMT Apr 1. Exchange signal report plus zone number. Final score equals number of zones worked times number of contacts. Contacts in own zone do not count as contact points. Mail all logs to L. M. Rundlett, 2001 Eye St., N.W., Washington DC 20006.

Here's a view of 73's Controlled Environmental Laboratory where we can put a mobile rig through a severe conditions test far exceeding any other devised.

Peter Stark K2OAW at the FM Symposium that was held last December in New York.

HAM HELP

Occasionally 73 receives letters from aspiring amateurs wanting to know if we can locate someone to help them get their license. Perhaps there are many more of our non-ham readers who also desire help.

Starting with this issue, we will publish names, addresses and telephone numbers of those desiring assistance. If you need help, don't be bashful about sending us your name . . . you do want your license don't you?

Each month, amateurs and clubs should look the list over and give a hand to those in their area. As new names come in, previous names will be removed from the list.

Earl L. Grove
891 Commonwealth Ave
Venice CA 90291
213-396-7315

1Lt Olin L. Beall II
530-34-8383
Hq Co
USA CCD
APO San Francisco CA 96460 (South Korea)

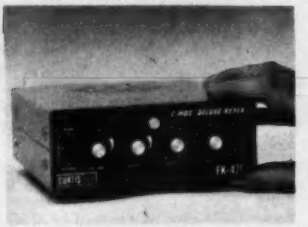
Oatley W. Wells
RFD 1
Concord NH 03301
603-746-3916

SQUEALERS NEEDED!

Anyone who has first-hand (personal) knowledge of radio violations should send specific details to the Chief, Safety and Special Radio Services Bureau, 1919 M Street N.W., Washington DC 20554; Attention: Legal, Advisory and Enforcement Division, Room 408. General information is useless; they need to know exact details such as whom, when, where, what, and why.

NEW PRODUCTS

FLEA POWERED KEYER



A super low-power electronic keyer employing complementary MOS (C-MOS) integrated circuits has been announced by Curtis Electro Devices, Inc.

The EK-420 C-MOS deluxe keyer offers self-completing dots, dashes and spaces, dot memory, iambic operation, built-in sidetone with 4" speaker, built-in power supply and reed relay for grid-block or solid state rigs. It operates on 115V ac or +4.5 to +14V dc.

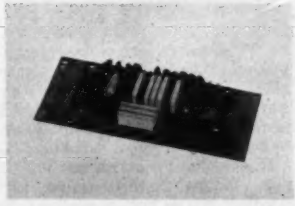
Because of C-MOS circuitry, the EK-420 consumes only ½ mW during standby. When keying, power consumption rises to 180 mW. This allows extended operation on an inexpensive snap-in transistor battery (9 volt).

A rear panel accessory socket allows instant connection of a soon-to-be-announced, four program 2,048-bit (200 character) memory unit.

Front panel controls include sidetone volume and pitch, weight and speed, tune, self-test, and ac-battery selector switch. All eight IC's, three transistors and the reed relay plug in to allow easy field service.

For more information contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040.*

MOTRAC TONE KIT



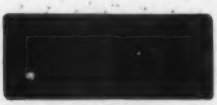
The new ALPHA SS-80J/192 subaudible tone encoder/decoder has been especially designed for use in the Motorola Motrac series of two way radios.

The SS-80J/192 utilizes thick film hybrid modules that contain all the active circuitry used for the encoding and decoding of tone. The thick film hybrid technique makes possible an exceptional degree of reliability under severe environmental extremes including high vibration and temperature from −40° to +100° C. The frequency determining modules are laser trimmed to the precise frequency required and are therefore not subject to the reliability problems of reeds and the frequency stability problems of tunable types of tone.

The unit is completely compatible with all Motorola, General Electric and RCA sub-audible tone systems and is available in standard or special frequencies from 20.0 Hz to 250.0 Hz. Provision has been made to accommodate up to six tone frequencies which may be electronically switched if required.

For additional information call or write *Alpha Electronic Services, Inc., 8431 Monroe Ave., Stanton CA 90680 (714) 821-4400.*

NEW COUNTER



Regency has announced an excellent new counter, the EC-175. This unit has six LED readouts, making it possible to read a 146 MHz frequency out to the kHz, which is extremely handy when you are tweaking a crystal on channel.

Regency has overcome one of the basic problems inherent in most inexpensive counters – the warm-up time – by letting the crystal oven run all of the time and having the front panel on-off control turn the rest of the unit on. And off. Thus the counter is all warmed up ready to go any time you need it.

There is a five position switch on the panel which moves the decimal point over, from where the last figure reads kHz, to where it reads 1/10th Hz! Thus a signal on 146.190 would be read that way in the first position. In the second it would read 46.1903, indicating that the crystal was 300 Hz high. In the third it would read 6.19037; 370 Hz high. In the fourth it would read 190.371; 371 Hz high. In the last spot you might get a reading of 90.3746; 374.6 Hz high. What you gain in accuracy you lose in time, as it takes about ten seconds to count out a tenth of a cycle reading. The MHz reading zips off as fast as you could want it, enabling you to put a crystal on channel while watching the counter without the usual wait for each count down.

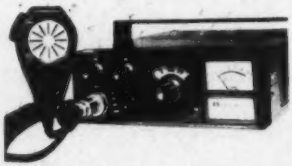
The sensitivity is a delight, too. One of the more frustrating aspects of some counters is that fiddling around to get the probe where there is exactly the right amount of rf to get a count. This can be quite difficult in putting receive crystals on channel. The EC-175 is as sensitive as any we've tried and is so hot that it can be turned up to where it will count a nearby radio station. During one test we were able to copy a nearby Novice on 15m just by watching the counter readout. The Novice was operating from the 73 Radio Club station about 100 feet away!

The unit is advertised to go to 175 MHz, but we had no problem in getting good readings at 220 MHz, so we don't know what the actual limitations are. The input impedance is 1 MΩ and sensitivity is 100 mV at 100 MHz. The time base stability (after 24 hours warm-up) is 2 parts in 10^8 for short term (24 hours), and 1 part in 10^6 for long term (6 months).

The ac supply is built in – or it may be operated from 12V dc, and it comes with a mobile mounting bracket. The unit is plenty small enough for the car, the same size as the Regency HR2 units. Price is only $449.

For further information contact *Regency Electronics, Inc., 7707 Record St., Indianapolis IN 46226.*

MIDLAND 220 RIG



Amateurs everywhere have been combing the ads and literature for the announcement of new 220 MHz gear. As was once the case with 2m FM, the lack of suitable gear has been keeping the band from really taking off. Even so, clubs around the country are starting to set up 220 repeaters and enthusiasm is growing daily.

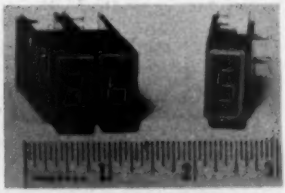
A new 12 channel transceiver has just been added to the ham market by Midland Electronics. It features a full 10 watts output with a separate power switch that reduces the level to 1 watt for short range contacts or "battery" operation with a separate pack. The receiver has an FET front end and ceramic filters in the intermediate stages for selectivity. The panel features a combination S/RF meter, 12 position channel switch, high/low power switch, volume and squelch controls and a transmit-indicator light. Inside the unit are separate trimmers for each transmit and receive crystal.

For further information contact: *Midland Electronics Co., P.O. Box 19032, Kansas City MO 64141.*

HAL ID1-A IDENTIFIER

HAL identifiers appear to be the standard of comparison. Virtually every area of the country has a repeater with a HAL CW identifier. In the past, the HAL identifiers have come as a complete circuit board for installation in a repeater. Now, however, HAL offers their ID1-A which includes its own rack panel with controls and speaker. Another great feature of the ID1-A is the ability to operate the unit from 12V dc in addition to 110V ac. This feature is particularly desirable if your repeater has provisions for operating on emergency 12V power in the event of failure of the 110 lines (which is not too uncommon at high repeater sights). Then too, the HAL ID1-A could also be used mobile. Imagine having your own CW-ID while mobile. W7DXX uses this feature while operating 2 meters aboard his Cherokee 140-D. If you are a CW operator the HAL ID1-A can be wired to sign your call at the touch of a button. Write *HAL, Box 365L, Urbana IL* for details

MINIATURE DECADE COUNTERS



Compton Electronics is offering a new line of miniature high-speed modular decade counters. The DEC-100 series of DECAPLUGS offers small size, operation from a single 5V power supply, and a unique side-by-side plug-in feature that allows fast assembly of any number of digits with no unit-to-unit wiring for main-

Continued on page 115.....

Bil Harrison, W2AVA, says

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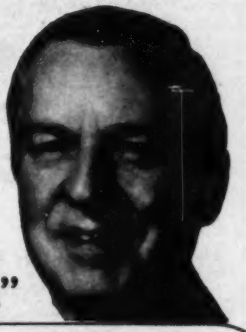

"Ham Headquarters, USA"

"I'm very competitive"

Ben Snyder, W2SOH, says

"That's right!" . . .

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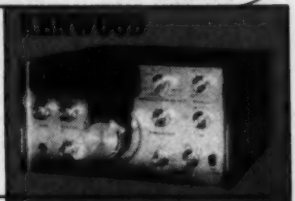
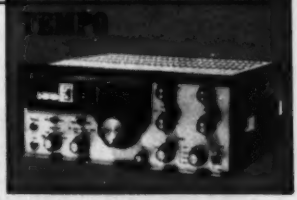


- TS 900 SSB TRANSCEIVER $745.00
- R-599 SOLID STATE RECEIVER $349.00
- T-599 HYBRID TRANSMITTER $395.00
- TS-511S SSB TRANSCEIVER $415.00

- R4B RECEIVER $475.00
- T4XB TRANSMITTER $495.00
- TR22 2-METER FM TRANSCEIVER $199.95
- ML2 VHF-FM TRANSCEIVER $299.95



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.....New Products continued.

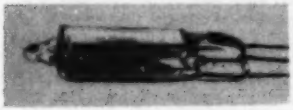
sequence operations. These devices utilize a line of miniature 7-segment incandescent readouts which are available in several optional styles. The DEC-100 up-down counter has preset capability, frequency response to 32 MHz, and mutual Vcc, gnd., load, reset, strobe, lamp test, up clock and down clock signal lines.

Full use of the 7447 decoder can be obtained from both the DEC-100 up-down and the DEC-101 up counter. This includes ripple-blanking, zero suppression, BCD output, and decimal point connections. Both units contain a latch for data strobe or data hold purposes. A variety of mounting schemes is possible, including the use of bezels with or without filters. Data lines to individual decades are connected through the use of solder pins, thus eliminating the need for special P.C. plug-in connectors for parallel entry lines.

Single unit prices for these modules are $29.50 for the DEC-100 up-down counter and $26.90 for the DEC-101 up counter, including readouts.

Contact *Compton Electronics, P.O. Box 5326, Compton CA 90224.*

TOUCH CONTROL SWITCH



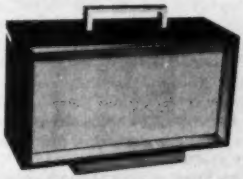
A new subminiature tube for touch control switching has been announced by Amperex. The device, designated ZA1006, is a neon-filled diode whose large and stable difference between ignition and maintaining voltages permits a highly reliable response when triggered by the body impedance of the toucher.

Touch control switching offers obvious advantages over mechanical switching. The reliability of the ZA1006 far exceeds that of mechanical selectors because it has no moving parts; operation is completely silent; switching is much faster than in mechanical devices, and switch status is self-indicating.

Ignition potential for the ZA1006 is 172 volts and its maintaining potential is only 107 volts. It draws only 3 mA of cathode current when switched on, and ignition delay is as low as 20 milliseconds. The light output is more than sufficient for reliable status indication, even in a well-lighted room.

Detailed information on the ZA1006 may be obtained by contacting *Mr. John Plump, Amperex Electronic Corporation, Hicksville Division, Hicksville NY 11802. Telephone: 516-931-6200.*

NEW CABINET LINE



Vector's new line of card cases, called Multi Mod, provides 27 basic models in a wide size range. Aluminum extrusions provide the package foundation. The dominant feature of all the cases is the four internal surfaces which have parallel grooves for positioning and holding circuit boards, mounting, or shielding plates. Circuit boards mounted in the grooves need no additional fastening devices. Due to the basic extruded design, some models provide as much as 60 dB of attenuation without special RFI gasketing.

The cases range in price from $2.40 to $10.00. Quantity discounts are available for immediate delivery. Modification of the cases to customer's specifications with special holes, panels, cutouts, etc., is offered. *Vector Electronic Company, 12460 Gladstone Ave., Sylmar CA 91342.*

WATTMETER HAS RF SAMPLING PORT

Model 4430 is the new THRU-LINE® rf Directional Wattmeter for the measurement of forward or reflected CW power with the additional feature of an rf sampling output for frequency analysis on a scope, spectrum analyzer or frequency counter.

The wattmeter is designed for ±5% power measurement from 100 mW to 1000 watts from 2 to 200 MHz and up to 500 watts from 200 to 512 MHz, using the same standard plug-in elements in discrete bands and power levels as cataloged with the famous model 43. No plug-in elements are needed for rf analysis. The sample signal is available from a BNC output port at about 53 dB below the main signal level. The price is $145 and plug-in elements range from $32 to $75. *Bird Electronic Corp., 30303 Aurora Road, Cleveland (Solon) OH 44139.*

HALF KILOWATT DUMMY LOAD

The new Model 8431 TERMA-LINE® rf Load Resistor has a continuous input power rating of 500 watts in the horizontal position and 600 watts standing vertically. This high power rating is accomplished by using minimum resistance paths directly from the dissipating element on a high-conductivity ceramic substrate to a fin structure modified for optimum coupling to the free air environment. These combined design features result in a dry load smaller and much lighter than comparable liquid cooled convection loads. Specifications include low VSWR of 1.1 from dc to 1 GHz, 1.25 from 1–2.5 GHz, continuous power dissipation of 500/600 watts in ambients from –40°C to +45°C, and 50 ohms impedance. The load weighs 13 lbs. and occupies less than ½ cu. ft. Price is $250. *Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon), Ohio 44139.*

.....W2NSD/1 continued.

hobby. The rules should be written for the benefit of the amateurs who are active and with a view of helping new techniques develop. The present system used by the FCC is creaky and cumbersome, and much too prone to being controlled by one or two men in the Commission. The times when a dictator is beneficial are considerably overshadowed by those when the results are cruel – and cruel is the considered opinion which characterizes the new repeater regulations.

Obviously we need a basic change in the way rules are promulgated for the amateur service. Many years ago we had a better system – a simple one. The ARRL would decide what rules the amateurs should have and

the FCC would enact them. This worked fine as long as the League was responsible, but eventually they took advantage of their position too many times and were too arrogant about it – I remember visiting the FCC many years ago and hearing them telling about Paul Segal, the ARRL's counsel in Washington, and his bragging that he was Mr. Ham Radio and, ha ha, he didn't even have a ham license!

Perhaps, if we can figure out a way to exert ourselves with the FCC, we may eventually be able to set up a yearly or biennial convention of delegates from major ham clubs who could form committees and report in proposed rule changes for the convention to vote on – with the result being passed along to the FCC for quick action.

Such a system would seem to solve a great many of the problems that amateur radio has had with bum regulations interfering with growth. Of course it would raise some problems with the hundreds of minor FCC employees who normally spend their years until retirement initialing papers and passing them along. It is this massive pile of paperwork that adds so many years to each proposal for rule changes – a snowstorm of memos sifting slowly through the civil servants in between coffee breaks and "conferences."

In the meanwhile, a man who knows the ropes in Washington could lean on people who are slowing up things – could see that a lack of communications was not making us suffer from bad rules – could protect us from the pressures of lobbies like the EIA – could coordinate amateur clubs to provide a reservoir of good will in the eyes of congress – and be on hand when things get sticky to grease the skids in our direction.

That goodwill thing. It's been some time since I've mentioned that, but there is a lot that can be done along this line. There are 100 senators and we should go out of our way to cultivate these gentlemen. What can we do? For one thing, we can have a representative of a local ham club near their home get in touch with them and set up an appointment for them to come down and meet the club – making sure that you have the best turnout in the history of the club, no matter how many friends of friends you have to drag in. And when you pick up the senator to take him to the club, be sure that the two meter FM gear is in perfect working order and that everyone on the repeater is rehearsed to put on the best show possible. You can orchestrate this to provide several interesting chaps talking about erudite subjects – and permit the senatorial car to break in and say hello – followed by several complimentary comments on the senator – not casual ones, but comments which show a good deal of interest in him – and then perhaps a stop at a local DX magnate's shack for a "casual" (but planned) rare DX contact or two – now how did that fellow in South Africa happen to know that your senator has been extra active in ecological legislation?

The meeting should be short and devoted entirely (in every detail) to the senator. No elections. No minutes of the last meeting. No new business. Etc. Introduce your key members – explain some of the interesting and valuable things they have done (this is perhaps better than just telling him what amateur radio can do) – explain some of the problems facing us – and some of the bright spots for our future. Don't ask him to do anything for you, or for amateur radio. You are putting money in the bank for the future. You might ask if there is any way that your group can help him and volunteer to provide communications in any way that it might be helpful in the future.

The above is just a germ of an idea – and I'm sure that as soon as your club starts thinking in these terms that many more ideas will come up. Needless to say, 73 urges and pleads that you share these ideas and accomplishments which may follow with the other readers.

Try, if you do get hold of a senator or a representative, to keep from being negative. Sure your club is all bent out of shape by the repeater regulation which calls for repeaters to be monitored night and day. It does not make sense. It seems stupid and without possible reason. But don't complain about that. Point out the good things and leave the bad ones until the day when we have the strength to face the FCC and request them to make the changes we need – and can back it up with some friends. When the time comes we will tell our friends what our problems are, but right now, when there is no solution in sight, it makes it look as if we are being friendly because we want something right now. Reasonable?

And, hey, don't forget a slow scan demonstration too – his eyes will pop out when he sees television pictures coming in from a few thousand miles away. If your big gun DXer has his nose so close to the ARRL country list that he hasn't gotten into SSTV yet, dig up a set from a more progressive local and take it over to big gun and set it up there. And don't forget to set up the scheds before the big visit.

Even when we have a closer acquaintance with congress, we still need a Man in Washington to coordinate. We need someone with a good ham background – with intelligence – with some experience in politics, Washington, or at least in persuasion. And we need some way to fund this Man – and to provide him with the information he needs to perform as well as the media to communicate to all radio amateurs. A column in 73 might be the answer to this since there is no censorship of the material that goes into 73.

If anyone has any good suggestions for providing a fund to keep a Man going, this is as good a time as any to put them to paper and send them in. He could get by on $25,000, but I would think that his job would be a whole lot easier, particularly at first, if there was enough money to rent a small office, hire a part time secretary, and pay a hefty phone bill.

Of course it is a whole lot easier to shrug off the problems and make do as best we can. After all, things are moving, even if slowly. The Novices did get some space on ten meters – which may not be all that valuable right now when the band is dead most of the time, but which eventually will be fun. And the Commission did permit vfo's, right? Well, not to take too much away from the FCC, they had already permitted vxo's, and the difference is pretty slight, so they were in a bind any way you look at it. The fact is that the Novice had a simple variable frequency system which had been okayed and which freed him from the tyranny of crystal control. By the way, in case you missed it, I was quite involved in getting that one through the FCC – and it was strongly opposed by the ARRL.

Repeater groups have a lot more to gripe about and a lot more reason to be up in arms about legislation. The recent docket set up rules so restrictive that, if they are observed to the letter, repeater service will be just about washed up. At a time when we have a need for a couple thousand more repeaters, we find that most of those that are presently active will have to cut back on their service drastically, if they are to be "legal."

Few phone ops are in any way satisfied with the miniscule expansion of the phone bands which the recent regs opened up. There is no indication that the thinking at the FCC is relevant – and, if you'll remember, it was a lack of relevance which helped to trigger off some of the student rebellions of recent years.

Sure we can live with the regulations. We can live with almost anything. We can even take up some other

hobby and the FCC can go jump in the lake. But perhaps there are some of us who have a feeling of responsibility, not only to our own interests, but to our country – and to the world. Amateur radio has a lot to offer and it needs devoted amateurs to keep pushing against the negative forces.

Perhaps I should publish more of the extremely negative letters I get – and my answers. I feel that strong negativeness is a psychological problem and I feel sorry for the fellows who write such letters – feel sorry for their families – for after all, I have to live with the person for the time it takes me to read and answer the letter and they have to live with him every day of the year – and there is no reason that he won't have the same attitude toward his family, neighbors and fellow workers as he does some ham problem.

On the other hand, for every negative bummer there are several amateurs who are enthusiastic about things – who want to help push us ahead. They may have legitimate criticism of ideas, but they usually follow it up with constructive suggestions, which are in the end of value. You'll probably find the same people in your club as I find arriving in the mail . . . some positive, some negative – and most apathetic. Though I don't know any good way to fight negativeness, apathy can be fought with ideas and enthusiasm.

How do we go about getting a lobby in Washington? We need ideas. We need constructive suggestions. Since the ARRL route seems to be a dead end, we need to come up with other methods. Perhaps we need some sort of association set up for this main purpose – an association to which clubs could join as regional branches. This has worked well in other fields. Let's have some input.

MISSING THE FUN?

It seems a real shame that so many FMers are missing the real fun of the hobby: keeping a repeater going.

Sure it's fun to break in and talk through repeaters – it's fun to keep in touch with a few cronies on one particular channel. But all this fun fades into insignificance when you undertake to put in your own repeater.

Take the Somerville (Mass.) group that runs WA1MHN on 07–67. They've been in the repeater biz for a while and decided they wanted to add a 450 repeater to the setup. Chuck Martin WA1KPS (of A&W Electronics) is one of the driving forces in this group, plus Joe WA1PQE, Dick K1KSZ, George K1MON and several others.

They decided, after looking over the topography, that the WA1KGO spot in Peterborough NH was one of the most likely places to put their repeater. It is high and makes it possible to put a good signal down all over Boston about 60 miles away. The 73 Radio Club enthusiastically endorsed the project and volunteered the space for the setup in the KGO repeater site building.

Since the mountain is covered with ice and snow for about one third of the year, Chuck invested in a pair of Ski-doo's, with trailer and caboose. Snowmobiles do well on snow, turning over now and then, but getting there. On ice they are something else. And ice is what it is a lot of the time.

The group would drive up from Boston, struggle the Ski-doo's from the 73 barn, manage to drag the trailer to the entrance to the mountain about four miles away, then have one hell of a time getting over the ice to the top. Once arrived, with only a few overturns on the way, the ice has to be chipped from the door to the building so they can get in. Someone has to climb the 50 foot tower and break the one foot of ice off the antennas that has accumulated. Funny how the antennas lose most of their zip when they are solid ice – it must affect the tuning seriously.

About the time the frostbitten tower volunteer staggers into the building seeking warmth, he trips over the heater power cord, shorting out the 200 amp 220 volt fuse – beautiful fireworks. It's pouring rain about now – did the flashlight fall out of the snowmobile when it turned over? The rain freezes solid wherever it hits. Soon the flashlight is found – tools are found to fix the flashlight – the fuse is then repaired and the heater haywired into the line again – and work can finally start on the identifier and other projects, the original cause for the trip.

Just before returning down the mountain the ice is broken off the antennas again – the KGO 2m antenna has folded in half with the ice load, but still seems to work fairly well even so. Neither of the snowmobiles will start. Once the carburetors have been cleaned they are workable, if balky. Everything is soaking wet and frozen. The trails are glassy ice and the snowmobile is designed for snow, not ice – so they glide all over the place, going dangerously near the steep sides of the mountain a lot more times than is comfortable. About half way down one runs out of gas.

You see what I mean by fun?

One of the two snowmobiles have finally been coaxed back down the mountain there is the job of getting them on the trailer again – naturally they slide back off every time you drive them on – and when you drive a little too fast they shoot on over the end and land between the trailer and the car, with the driver pinned between.

How can you bear to pass up fun like this? Give some serious thought to getting involved with repeater installation and maintenance.

MINIATURE REPEATERS

With more and more VHF modules coming available such as the International Signal and VHF Engineering units, we have the makings of small repeaters. The fact is that all that is needed in many communities is a very small and simple repeater – 100 milliwatts is quite adequate, if it is well placed. We'd like to see articles on putting small repeaters together – on using them – on control and identification circuits–antennas.

We need small repeaters to help out at hamfests and conventions, both for communications of the organizers and the visitors. We need emergency repeaters that can be set up for temporary traffic handling. We need repeaters for smaller towns and for small areas of bigger towns. There is no reason why a repeater in a small section of Brooklyn has to be available for all of New York – or why the amateurs in and around Malden (Mass.) can't have a little local machine. When they want to talk further they will use another channel.

We need information on setting up these small repeaters. With the International signal transmitter and receiver units, how much separation is needed between the units if they are set up with 600 kHz split? How much for one meg split? What differences does it make in the amount of antenna separation? Let's have some data on all this.

IMPROVEMENTS TO 73?

While most of the 73 staff is spent busily working its way through the woods of publication, now and then we do try and step back as far as possible and look objectively at the magazine and come up with ideas for changes and improvements. The probability is that we are too close to the whole thing to have any perspective.

The fact is that ideas are not just welcome, but are solicited. We have in mind constructive ideas, rather than letters telling us how terrible the magazine is. What do you think about the developing newspages? Should we spend more time on them or less? They take up a fantastic amount of time to get ready compared to the articles and ads, but if they are

making amateur radio more fun, then they are worth the time and space they take.

The measuring stick should be just that: more fun. In general, the more you know about something, the more fun you can have with it. Thus we try to cover as much of the hobby as we can. It may appear that we are going overboard on new aspects of amateur radio – but keep in mind that there is tremendous resistance to new things and without this pressure, many amateurs would never be moved to try the new phase.

FM and repeaters were around for several years, almost ignored by the ham magazines – and growth was insignificant. Once 73 was able to get articles on FM into print in quantity, everything changed and enormous growth was experienced. A lot of readers resisted FM – hated seeing all those articles – many still are resisting and hating. But FM is fun and as such as worth the promition and extra effort.

There are many other areas of fun that need developing – slow scan television has just scratched the surface – QRP is a ball and needs a lot of push – and it just may be possible that facsimile is around the corner! If you are one of those people who are pushing ahead instead of trying to hold everyone else back, it is possible that you have found an area of fun that needs to be written about. Do it.

Back to 73 again – and ideas you may have for improvement. Should we have more short columns on special interests? Fewer? Longer columns? More news? More editorials by people who are into new things? Too wild? Too tame? And the articles – do you like the idea of more book-length sections? Should we have more of the longer and esoteric construction projects that have been appearing in Ham Radio? Our practice has been to bypass these, but if this is wanted, so be it. Generally we try and make at least 90% of the magazine understandable to the average amateur, and hold the really high level engineering stuff to a minimum. Perhaps you've noticed that if there is any way to keep calculus out of articles, we go that route.

If there is something you don't like much, let us know, but don't forget to tell us what you'd rather have in its place. Remember that 73 is a magazine written 95% by the readers, not by a bunch of stuffed shirts who are insulated from the hobby. The editors and publisher are active in all aspects of amateur radio.

BALLOONS

Longer ago than I like to think, back when I was editing another better unnamed magazine, I remember hearing from some amateurs who had gotten involved with ballooning. Two meters and all that.

An article in a recent National Observer stirred the memories of some of the stories these chaps had to tell and I got to wondering if any amateurs are involved with ballooning today? I've done a lot of different "mobile" two meter work, but I haven't heard of anything like this.

Somehow I suspect that a lot of readers would be interested in hearing about this. If any readers are involved with ballooning, how about telling us about it?

And speaking of mobile operation – it would be nice to get pictures of as many different types as possible – they could make the newspages. I've snowmobiled, skimobiled, horsemobiled, footmobiled, bedmobiled and swivelchairmobiled – how about you?

LIGHT CONVERSATION

How can it be that when there are so many thousands of interesting things to talk about, that the average ham contact is a bone-dry bore?

The problem is, of course, how to get into interesting areas of conversation – and this is difficult. Most of us need to consciously think about this and try to work out ways of getting conversations started.

You can't just say hello and ask if the fellow you are working knows that the spending of our lives under artificial light is having some profound effects that are not generally recognized. They have some new lamps which have the same spectra as the sun and the results they are having in experiments with these are fantastic – better teeth – better intelligence in children – offices work smoother – better health in general – and so forth (my dentist, a 73 subscriber, lent me a report on the subject). A report like this is good for dozens of contacts, if you can figure how to get it into the conversation.

And how do you come across interesting reports like that? You achieve a reputation for being interested in new ideas – you talk about new and different things over the air – and the first thing you know, your acquaintances will start noticing things that might be of interest to you – maybe sending you clippings. They might even start reading about such items themselves and thus make their contacts more interesting.

If you'd like more information on the sun spectra lights, drop a note to Duro-Test Corporation, North Bergen NJ.

More to Talk About

Another book which is chock full of incredible new ideas and which, if you can figure out how to get things like this into your conversations, should keep you going for weeks – or longer. Of course you may get a reputation as a nut for believing in such things, no matter how well researched they are, for they are mostly alien to the current beliefs of American scientists. This book is called *"Psychic Discoveries Behind the Iron Curtain."* Bantam paperback 05681, it is a fat one and sells for $1.25. If this doesn't get your interest up, you have a problem.

If you run across someone who doesn't believe in hypnotism or telepathy you can have a field day telling him about the carefully controlled scientific experiments in Russia where people were hypnotized by telepathy – complete with eeg monitoring of both senders and receivers. Is it possible to put someone to sleep and wake him ten times in a row from a thousand miles away – all on cue? Read.

Another interesting new book, if you like things of this nature, has to do with how to avoid pains in the body. Many of us suffer from time to time from back pains, headaches, and such. The book, *"Orthotherapy"* by Michele (M.D.), $1.25 Dell 6718 just might make a world of difference. It sure would have helped my life if this book had been available many years ago – even for my parents. In a couple of days you could become the voice of expertise on how to get rid of body pains.

Have you read anything which might help us be armed for interesting contacts?

PSYCHO-LEARNING

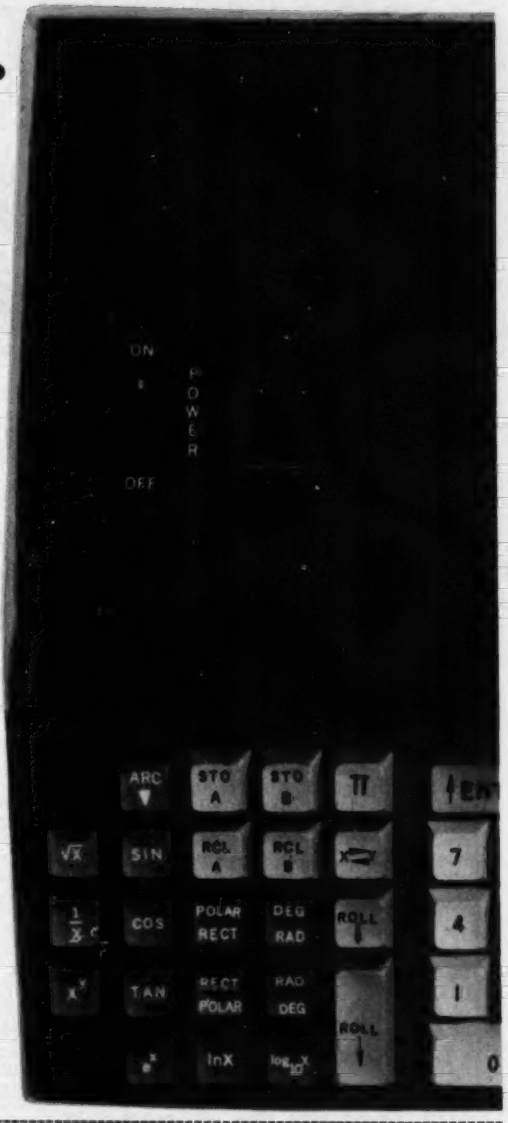
One of the recent developments behind the Iron Curtain is the experiments in what is called psycho-learning. These techniques have been developed primarily in the area of language teaching, but they would seem to be equally applicable teaching amateur radio theory.

Without going into long details on the hows and whys of the system, I'll just give the basics of how you go avout applying the idea. I'd like to have some radio clubs give this a big try and see how well it works for them so we can report on it.

The experiments in Yugoslavia with language classes have been fan-

Continued on page 125.....

A NEW STANDARD!... THE 7400 SCIENTIFIC & ENGINEERING CALCULATOR



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13-12

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Additional Memories 500 bit $21.50
1000 bit $37.50

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500 or 800 bit R/W memory. Stores either a single message or a number of sequential messages. "Message Stop" for char. insertion. Near-full and Overload alarms, remote control for Stop/Start of message. Incl. SM-21B features. Sh. wt 4 lbs. (500-bit memory) $198.50
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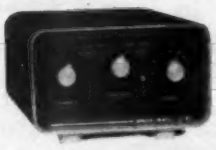

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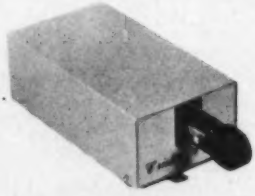

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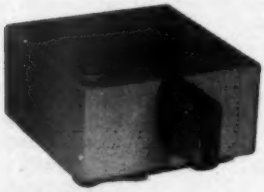

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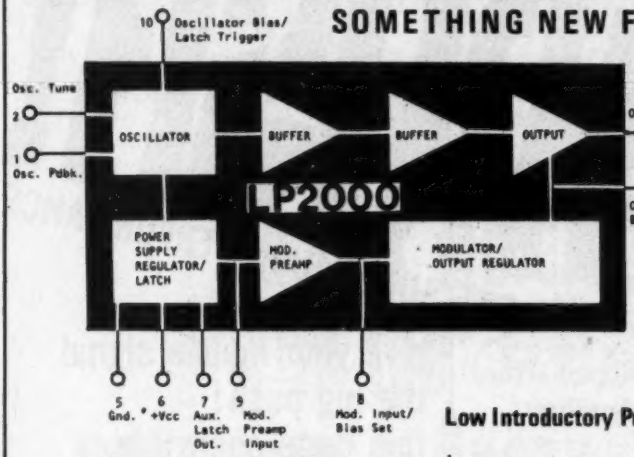

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MODEL CGT-144 (illustrated) antenna complete with trunk lip mount for easy, no holes installation on side or edge of trunk lip. 180° swivel included for adjustment of antenna to absolute vertical. Supplied operational with 17' MIL spec RG-58-U and PL-259 transceiver connector factory attached. Antenna is removable from mount. Shpg. Wt. 3.34 lbs. **$36.95**

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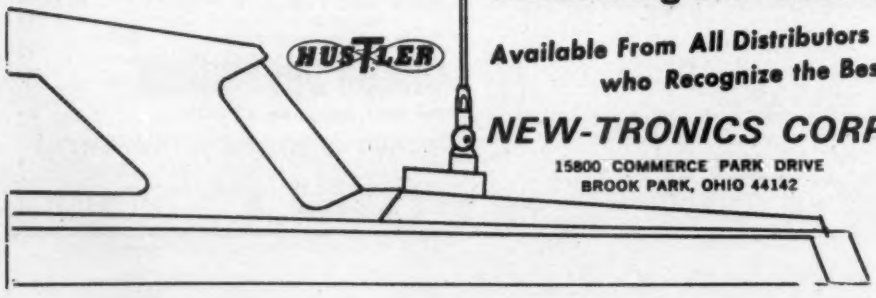

give your mobile signal the big push! this large aperature, two meter antenna will create a new dimension in amateur mobile communications. —where action counts, get the decisive advantage of colinear power gain performance; transmitting and receiving!

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be "who's who" on two meters with the HUSTLER 6db gain colinear

MODEL G6-144 . . . $39.95

ELECTRICAL:
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MECHANICAL:
- Radiator: 119" x 1" — ⅞"-⅜" OD high strength aluminum tubing
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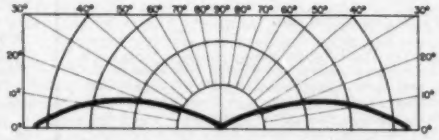

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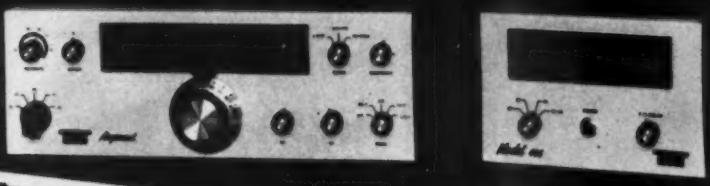

and LINEAR AMPLIFIER

GOT A MINUTE?

SPECIFICATIONS

ARGONAUT, MODEL 505

GENERAL: Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Automatic sideband selection, reversible. Solid state design. Permeability tuned circuits. Seven plug-in circuit boards. Direct frequency readout. Vernier tuning. Dial accuracy ± 5 kHz (slightly more at 10 meters). Drift less than 100 Hz. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

RECEIVER: Sensitivity less than ½ uV for 10 dB S+N/N. "S" meter. AGC. Offset tuning. Tuned MOSFET RF amplifier and mixer. Audio distortion less than 2%. Internal speaker. Headphone/external speaker jack.

TRANSMITTER: 5 watts input power. Broad band final amplifier eliminates tuning. 50-75 ohms output impedance. Press-to-talk. Instant CW break-in. SWR bridge. Integral TVI filter. CW sidetone. Integrated circuit balanced modulator. Automatic CW offset of approximately 700 Hz. Shaped keying.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. Broad band design eliminates tuning. Less than 2 watts of drive required. RF wattmeter. SWR meter. Exciter actuated antenna changeover. Front panel T/R time delay control. Individual band-switched low pass filters. TVI filter. Two plug-in circuit boards. Computer estimated life of output transistors 25.7 years. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

The ultimate in station flexibility—the Argonaut plus the "405" Linear Amplifier. You can enjoy the fun and extreme portability of QRP yet put a clean 50 watts into your antenna by adding the "405".

The Argonaut alone is capable of great performance. Users all over the world are reporting sensational results. It is ideal for QRP fun, travel with restricted space and weight, and operation when commercial power is unavailable. The "405" solid state linear amplifier brings the Argonaut into the medium power range by increasing the RF output 25 times. Yet both are simple in operation and installation. Broad band amplifier designs eliminate tune-up. Change bands in seconds. The Argonaut and the "405" weigh but 8½ pounds and occupy just 2/5 cubic foot of space. Add the AC power supply and the weight is 16½ pounds and they displace just ½ cubic foot. For a home station this allows room for operating conveniences and for traveling and mobile, it solves a lot of space problems.

Argonaut, Model 505	**$288.00**
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tastic – and people have been learning languages at a speed never thought possible before. This has been particularly true in the case of getting large vocabularies into the memory – the toughest part of learning languages. Just think how great this would be for electronic theory!

But, down to the nitty gritty. You will need some soft lounging chairs where the people can sit back and relax completely, feet up and totally at ease. You'll need a good hi-fi system to provide background music to help relaxation and permit the mind to kind of free wheel. Then you'll want a tape system or a public address system for reading the theory course to them. The 73 study course should be ideal for this, by the way. The sessions can go a half hour or so and there is no need to do anything but just sit back and relax and let the music open up the mind while the theory goes in – and then, as if by magic, the theory will all be there when you need it. This is sort of like sleep learning, except that it works.

Give this sytem a try, if you please, and let us know what results you get. The Yugoslavs have been learning languages in weeks that would normally take months, so it would appear to be a legitimate system.

NEEDED ARTICLE?

How about an article on a little unit that will fit in the car to hold a hand transceiver – charge it – and use it as a mobile rig, complete with an amplifier? This should be a snap with the TR-22 – easy with the SR-C146A and not too difficult even with the KP-202 and the FMP.

ONE MEG

At the recent FM Symposium in Medford (Mass.) a chap speaking for the semi-defunct Northeast Repeater Association tried to stop all discussion of a one megahertz split for repeaters.

My feeling was that if the idea has no merit, then a discussion of it will kill it. If the idea does have sufficient merit, then talking about it will spread the idea – but that censorship and trying to shut people up and prevent them from talking about it is the worst way to go. The Association tried the same stunt at the Symposium in New York in Dcember.

There are many technical reasons why one meg is a good scheme – there are reasons why we should stick with 600 kHz. This is not the place to try and cover the subject, only a spot to talk about discussing it.

George K1TKJ, the chief op of WA2SUR, New York's busiest repeater, has announced that he will be putting WA1KGK back on the air soon in southern Connecticut – and it will be on a one meg split with the input on 147.49 and the output on 146.49. George is as knowledgeable as they come and few repeater groups are able to listen to his arguments in favor of one meg without starting to think seriously of making the change, even though they may have just recently made the 600 kHz decision.

Watch for a surprise announcement soon that WA2SUR will be going one meg! The plan is to put the input on 147.73 and leave the output on 146.73. This will open up the 146.13 input channel if any group wants to set it up with a 147.13 output.

As I see the situation – without any discussion of the merits and problems of one meg, we can look forward to repeaters going this route anyway. The standard channels in the 146 and 147 meg segments of the band are rapidly filling up in urban centers – and this will leave the six simplex 146 channels and the six 147 channels as the only spaces for further development. At present only about one or two of those channels has actually gotten used for simplex, so in essence the othes are open for repeaters and, as you know, nature (and repeater groups) abhors a vacuum.

This would have us end up with 600 kHz repeaters in the present repeater segments and one meg repeaters in the simplex channels. Do we want to go this route or is it time to bring the facts out in the open and discuss them so we can try to have orderly development?

QRRR?

During a recent visit to New York for a round of Christmas shopping, some movies, and such, I wore out a good deal of shoe leather hiking from one part of Manhattan to another. I also kept my batteries down by either talking or listening quite a bit to WA2SUR with my SR-C146 hand unit.

A little hand unit gives one a sense of confidence when walking around New York. It's been over ten years since I pulled up stakes after living there off and on for 30 years, and my folks for over 60 years, and I find that visiting "home" is a lot different today than it used to be. New Yorkers joke a lot about being mugged – I guess that's the only way they can live with the situation – but the fact is that ten years ago I could walk just about anywhere in New York and never give it a moment's thought. Oh, I had the common sense to stay out of Central Park at night, but I never worried about the streets or subways.

Now I find that I worry a bit. If I am going down a long block at night and the only people around are a group of several tough looking boys, I think about it. It is at times like these that a hand unit gives courage. For that matter, after thinking about it, I suspect that a unit on a belt would discourage mugging since about the only people who wear them are police.

The things that I heard during my moments of listening over a period of two days makes me wonder. Perhaps I am a lot more tuned to what is news than most FMers, but several of the things that went through SUR came under the heading of news – and it is a shame that someone with a little time in Gotham doesn't take notes on these things and send them in to 73. Amateur radio needs all the PR it can get and there is a lot of it going down the Hudson Tubes.

It is a matter of interest perhaps to record that I had a nice contact with WB2UEZ aboard the Staten Island Ferry, with me footing it across 57th Street. Then, as I reached 62nd Street and Lex, it happened – an emergency! I listened while a report came through from WA2YJZ that a car had broken down on the Brooklyn Belt Parkway and was blocking traffic. There was a long pause. YJZ asked again if there was anyone on channel to call the police. Silence.

I noticed a phone booth on the corner opposite me, so I volunteered to make the call. The nice lady who answered my "911" said that I would have to call 566-3406, that she could not take the report unless someone was hurt. Okay, big deal, so it costs 10¢ – the gal on 3406 said that I had the wrong burough, that I should call another number for trouble in Brooklyn – and I said hold on here now, I'm trying to be helpful so don't make it difficult for me – and she said well all right, where's the accident.

When I finally gave her all the information I stepped out of the booth and called YJZ to let him know that the report was in and acknowledged. I was interrupted by WA2OMZ with an accident on the Major Degan – with an ambulance needed right away. I tried 911 and found them most cooperative when I had a damaged person involved. They took down the location of the accident and said they would get the word out immediately.

By the time I reached 65th Street, OMZ called to say that the ambulance had arrived and picked up the woman, who was in shock.

Now this may be an everyday occurrence to the blase SUR addicts, but it is exciting and hot news to those of us from the sticks – and by New York

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

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MODERNIZE FOR PEANUTS! Frame & display QSL's with 20 pocket plastic holders. Two for $1.00, seven for $3.00. Prepaid, guaranteed. Universally used and approved. Order now. TEPABCO, Box 198S, Gallatin, Tennessee 37066.

TECH MANUALS – $6.50 each: R-220/URR, R-388/URR, R-389/URR, R-390/URR, R-274/FRR, CV-591A/URR, TS-34A/AP, TS-497B/URR, SP-600JX-27, TT-63A/FGC, ALR-5, LP-5, LM-21, OS-8A/U, W3IHD, 4905 Roanne Drive, Washington, DC 20021.

FREE KIT CATALOG: Tone Encoders, Decoders, Scramblers, Alarms, Sounders, Automatic Telephone Recorder Phone Patch, IC Kits and more KRYSTAL KITS, 2202 S.E. 14th, Bentonville, Arkansas 72712.

EVANSVILLE, INDIANA TARS Hamfest. Sunday May 6, 1973. 4H grounds Highway 41 North 3 miles. For flyer contact Robby W9MKZ, 502 S. Lincoln Park Drive, Evansville, Indiana 47714.

WANTED OLD RADIO TRANSCRIPTION DISCS. Any size or speed. Send list and details to Larry Kiner, W7FIZ, 7554 132nd Ave N.E., Kirkland, Wash. 98033.

GREATER BALTIMORE HAMBOREE, Sunday April 8 at 10 A.M. Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland 21204 (1 mile south of Exit 28 Beltway-Interstate 695), Food Service, Prizes, Flea Market, Registration $2.00. No table charge or Percentage. INFO. Contact W3WVC at School Address.

STERLING-ROCK FALLS HAMFEST March 11th. INFO Box 11, Sterling, Ill. 61081.

CANADIANS – FREE 120 PAGE ELECTRONICS CATALOG. ETCO, 464 McGill, Montreal.

TO SELL YOUR HAM GEAR or to purchase new or used or to receive our monthly mailer of reconditioned equipment contact Associated Radio, 8012 Conser, Overland Park, Kansas 66204. 913-381-5900.

SOLID STATE Model T1352 Motorola RCC 7-Channel Secode VP Call Head, Antenna, Cable. Cost $1488 Sell $690. 610 S. Arroyo Pkwy, Pasadena, Ca. 91105 213-684-2000.

WA8TMR deceased. Wife must sell Swan 500CX single sideband transceiver and Power Supply 117XC. Excellent condition. Mrs. John Sercia Box 144, Brookfield, Ohio 44403.

GREATER BALTIMORE HAMBOREE, Sunday, April 8, at 10 AM, Calvert Hall College, Putty Hill and Goucher Boulevard, (one mile south of Exit 28-Beltway Interstate 695), Towson, Maryland. Registration: $2.00. No table charge or percentage. INFO: Joe Lochte, 5400 Roland Avenue, Baltimore, Md. 21210.

"22nd ANNUAL Dayton Hamvention will be held on April 28, 1973 at Wampler's Dayton Hara Arena. Technical sessions, exhibits, hidden transmitter hunt, flea market, and special program for the XYL. For info write Dayton Hamvention, Dept. M Box 44, Dayton, Ohio 45401."

HERE'S YOUR CHANCE. Regency HR-6 $190, HR2MS 8 ch. scanner 15W $255. TME-H-LMU 16 ch. scanning rcvr 6/2/¾/m $255. Digital logiclock $75. Tempo CL220 12 ch. $265. Everything brand new. Box 310, 73 Magazine.

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FOR SALE: SRR-13 receiver – working – as is – w/manual $75.00 CV-591 SSB converter $60.00 Shipping prepaid. Pat Butler 3829 N. Harmon Peoria, Illinois 61614.

SIGNAL ONE CX7-A w/spkr and CW filters, amazing deal at $1500. Hallicrafters FPM 300 SSB xcvr $480. Heath IB-101 frequency counter with Vanguard scaler $250. Heath SB200 linear 2 KW PEP $330. Box 230, 73 Magazine.

FOR SALE – Brand new Heathkit all assembled SB 301 receiver and SB 401 transmitter. Selling due to demise of W1MC. $500.00. E. Corby, 70 Crown St., Trumbull Conn. 06611.

2 METER FM – SR-C 145 Handie Talkie transceiver brand new, complete with carrying case and American instruction booklet $190.00. Joe Gibson, 181 So. Orchard St., Wallingford, Conn. 06492.

WANT HT-220's – best prices paid – now's your chance to get enough to buy a six channel fast charge Japanese HT. Give details and price first letter. Box 95, 73 Magazine, Peterborough NH 03458.

ANTIQUE radio equipment sale and swap session, dinner and program, A.W.A. Spring Meet, April 7, Canandaigua, N.Y. Write for details: Lincoln Cundall, W2QY, 69 Boulevard Parkway, Rochester, N.Y. 14612.

YOUR CALL LETTERS. Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

VHF GEAR: Comco AC ground to air $50., Stoddart NMA4 receiver 88-400 MHZ plug-in $195., Fairchild T power UHF FB $60., New Hy Gain 64B beam $10., several BC348 HF receivers part AC converted. Basket cases: TI dual chart recorder and Rootes type super charger. Most with schematics. Wilson, WØKGI, 407 Pinebrook Hills, Boulder, Colo., 80302, 303-447-8692.

GONSET HAND MIKE. Press to talk w/coil wire–6.00; Whip antenna w/spring mount, tuneable 140 to 175–4.00; Johnson 160-107-16 trimmer capacitors 6/1.50; NPO trimmers 3–12 6/1.00; Cinch terminal strips, series 140-Y 8's 6/1.00; Phone jacks, shorting type 2 conductor 5/1.00; Sweeptube 12 pin socket 6/1.00; 9 pin miniature socket 12/1.00; Wafer switches, assorted 4/1.00; Pots, assorted 8/1.00; 7.5 Mc Filter $5.00; Collins Mechanical Filter 455–160 15.00; Collins Mechanical Filter F 500 Y 60 10.00; 24 VDC Gyro. 4x4x6 (not 400 cycle) 12.50. All Items Brand New and Postpaid. Surplus Electronics, 126 W. Tremont, Charlotte, N.C. 28203.

standards, most of us are living in the sticks. Come on all you fellows in New York – get organized a little bit and let the rest of the world know what a day on SUR is like!

With a few cases like that we could make beautiful music to congress – to the FCC – to the newspapers. If FMers will send in reports of things like this, they will make the 73 newspages – and we reprint these from time to time for congress. Without your help and interest we have little to tell.

DAYTON -- ONLY ONE DAY!

The PR for the '73 Dayton Hamvention arrived and we see that it is again going to be a one day affair. Curses! There is just too much doing in that short time. Between the world's largest flea market – the busiest program schedule of any convention in the country – the largest manufacturer's exhibition – and the largest conglomeration of hams who want to meet and talk with each other, there is just no way to even get half of it all done in one day.

Compare that to the four days for the Saroc convention which has perhaps one quarter or less the participation in people and manufacturers, and no program whatever worthy of note.

The result is that you have to decide whether you are going to the slow scan talk – the FM talk – the DX talk – or a MARS or Midcars meeting, all at about the same time. Pity the DXer who uses SSTV and is also on FM. If an amateur has any reasonable number of interests he never has a chance to get to the exhibits or the flea market.

Reason would seem to dictate that Saroc be cut to one day and Dayton stretched out to a whole weekend.

NORMAN LICENSE REVOKED!

One of the bombshells at the Saroc convention was news that the man who has run the convention as a one-man effort for these many years, Leonard Norman, had been recently called up by the FCC for reexamination of his Conditional Class license – and FAILED!

The Commission has been checking out Conditional and Technician licenses in various areas in recent months, in many cases following up on reported cheating. The high percentage of tickets sent in without even an attempt to pass the exam has raised eyebrows in Washington.

It is not known whether the Norman recall was routine, the result of a report on cheating, or even possibly involved with the FCC reaction to jamming of Wescars by two Las Vegas amateurs.

TIME FOR HISTORY

Say, old timers, some of you are getting along a bit and there is a chance that you might take some information with you that ought to stay here.

How will you feel in the next "life" if the only record of how things were was what historians are able to glean from back issues of QST?

We do need to have some sidelights on the middle years of amateur radio – on what really happened in the 30's – and the 40's. I began to be deeply involved from the 50's on, once I got into ham publishing, so I can take it from there, but nothing much has ever been written to fill everyone in on the Warner and Budlong years of the League.

A lot of the newcomers to amateur radio would like to know more about our history – and there are a lot of old timers out there who were quite involved with the making of that history. Let's get cracking and write some articles on this – who knows, we might end up with a book.

SUBWAY MOBILE

One day, while in New York doing some shopping, SR-C146 in hand, I broke into WA2SUR during the few minutes that the subway train takes to cross the Manhattan Bridge and had a short contact. The chap I managed to snag was complaining about my being in favor of one meg split.

Though time was limited, I tried to explain that the one meg split was, first of all, not my original idea – and secondly that it was no big deal to me one way or the other whether repeaters were 600 kHz or one meg. I pointed out that I felt that my function was to act as a communication medium, making sure that ideas are given consideration. If one meg is accepted it will be no feather in my cap – it will be to the credit of those that put it into action, if it works out well.

Then I asked the fellow why he was so bitterly opposed to any repeaters changing to one meg. He explained that he was a student and couldn't afford to buy a new crystal for WA2SUR, since he had so little money.

I reflected awhile over the concept of one man trying so hard to stop an idea on the basis that 50,000 or so amateurs should accept what he wants because he doesn't have the get up and go to earn $3.75 for a new crystal. Since I was on the air I didn't mention that 73 is looking for area representatives who can make good commissions selling subscriptions to 73 – or that there is money waiting to be picked off the trees (figuratively) in the security field – or that there are quite a few books on the market showing how to make good incomes in your spare time. There are so many ways to make money that it seems as if no one should ever be short of it.

FILM PROJECTS

Many clubs have at least one member who is into 16mm or super 8mm films. As a club project, you might talk over the possibility of producing a film for distribution to other clubs – or even distribution outside of amateur radio to other types of clubs. We need films which show the benefits of amateur radio – the fun to be had – the things we accomplish.

You could plan a film on moonbounce operations – or on repeaters – special projects of your club – DXing – helping the handicapped. There are a large number of approaches to making an interesting and valuable film.

Once you have the film made you can let it be known through the ham magazines that it is available for showing. If you charge enough for rental to pay for the print, you can have a little income for the club. And think of the prestige for the club!

ARE YOU A WRITER?

Perhaps you get the urge to write. There are so many things that amateurs would be interested in that one hardly knows where to start. You might tell about the most exciting contact you ever had – or the most unusual – or maybe what technical advances you see ahead in the next few years – what will the ham bands be like in the future – how about FM sets in a couple of years?

Or perhaps you've built something new and interesting. It does happen that amateurs are right in there on the newest of developments and not much comes out that a ham hasn't had a hand in. Let's keep the readers up to date on new developments. If you build a one chip receiver, write it up. Or a one chip transmitter. Etc.

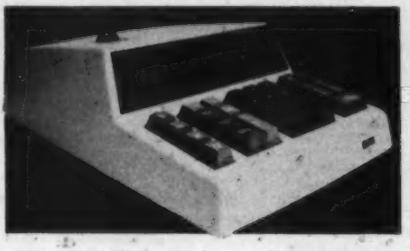
. . .Wayne

2 METER RIGS. Standard 826M $250. Simpson Model B $200. Mini-Vox walkie-talkie w/charger and xtals, worth $300, only $175, GLB synthesizer, works with any rig, $150. Also Galaxy V SSB xcvr w/p.s., accessory console and ext. VFO, $350. Box 220, 73 Magazine.

SELL: E.E. and other technical books. SASE for list. Roger A. Baim, WB9BDP, 1753 W. Coyle, Chicago, Ill. 60645.

HT-220 two watt two channel with case – best offer over $75. Box 12, 73 Magazine, Peterborough NH 03458.

our fourth generation family...

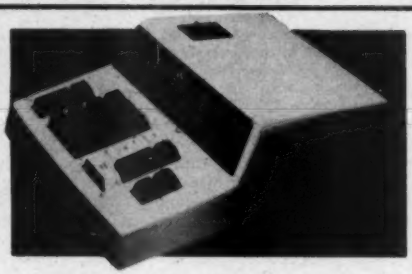


Square root operation and fourteen digit LED display makes this machine the choice of those who want the very best.

Sophisticated functions (made possible by unique MOS-LSI circuitry) include a constant data memory, 14 digit independent data memory, negative number entry, and exchange of operands . . . all are one touch operations!

MITS has provided expanding capability for the 816 and 1440 by providing interfacing for the soon to be released programming module and printer to convert the basic unit into an impressive desk top computer.

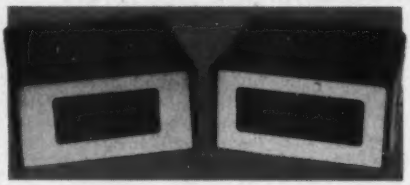
1440 Kit $199.95
1440 Assembled . . . $249.95



16 digits, the highest output capacity of any MITS calculator, are available on the 816 models only. Constant data memory and computed fixed decimal system makes the 816 a useful tool for business or home use.

Human-engineered color coded keyboard and large electro-flourescent display gives both 816 models a degree of operating ease and flexibility unmatched in machines costing hundreds more.

816A Kit $149.95
816A Assembled . . $179.95
816B Kit $159.95
816B Assembled . . $189.95



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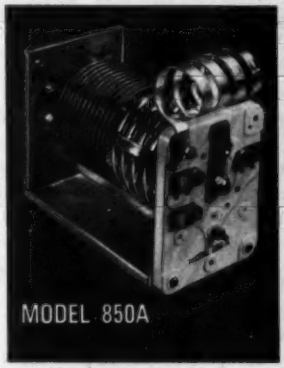
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MODEL 852

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PLATE LOAD IMPEDANCE	2500-5000 ohms	2500-5000 ohms	1500-3000 ohms
BANDS (Meters)	80-40-20-15-10	80-40-20-15-10	80-40-20-15-10
INDUCTANCE TAP (Each Band)	13.6-6.5-1.75-1.0-0.8 UH	14-6.3-1.6-0.87-0.52 UH	7-3.72-2.34-1.34-0.95 UH
Capacity To Resonate Each Band	150-80-70-55-50 MMFD	150-80-70-55-50 MMFD	268-144-73-48.5-36 MMFD
OVERALL DIMENSIONS (Length, Width, Height)	10" x 4½" x 7½"	7" x 3" x 3½"	10" x 4½" x 8"
OUTPUT IMPEDANCE	50-75 ohms unbalanced	50-75 ohms	50-75 ohms unbalanced
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261 Commercial duty 1/4 wave, claw mounted roof top whip. Precision tunable to any discrete frequency 108 thru 470 MHz. Complete with 18' of coax and connector. 17-7 ph stainless steel whip.

260 Same as above. Furnished without coax.

262 Rugged, magnetic mount whip. 108 thru 470 MHz. Great for temporary or semi-permanent no-hole installation. Holds secure to 100 mph. Complete with coax and connector. Base matching coil for 52 ohm match. 17-7 ph stainless steel whip.

263 Special no-hole trunk lip mount. 3 db gain. 130 thru 174 MHz. 5/8 wave. Complete with 16' coax. Operates at DC ground. Base matching coil for 52 ohm match. 17-7 ph stainless steel whip.

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269 Rugged, durable, continuously loaded flexible VHF antenna for portables and walkie talkies. Completely insulated with special vinyl coating. Bends at all angles without breaking or cracking finish. Cannot be accidentally shorted out. Furnished with 5/16-32 base. Fits Motorola HT; Johnson; RCA Personalfone; Federal Sign & Signal; and certain KAAR, Aerotron, Comco and Repco units.

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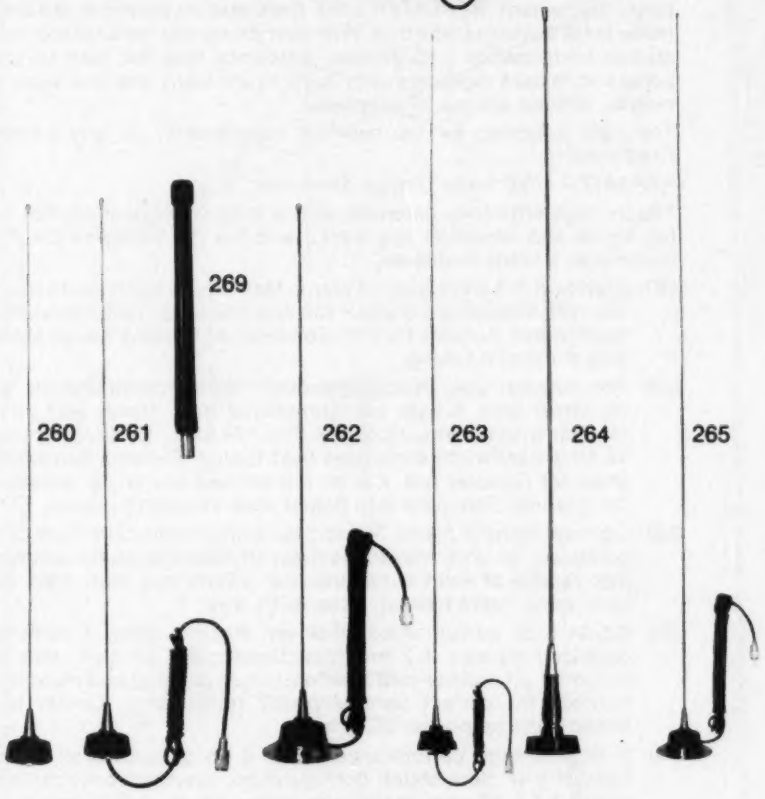

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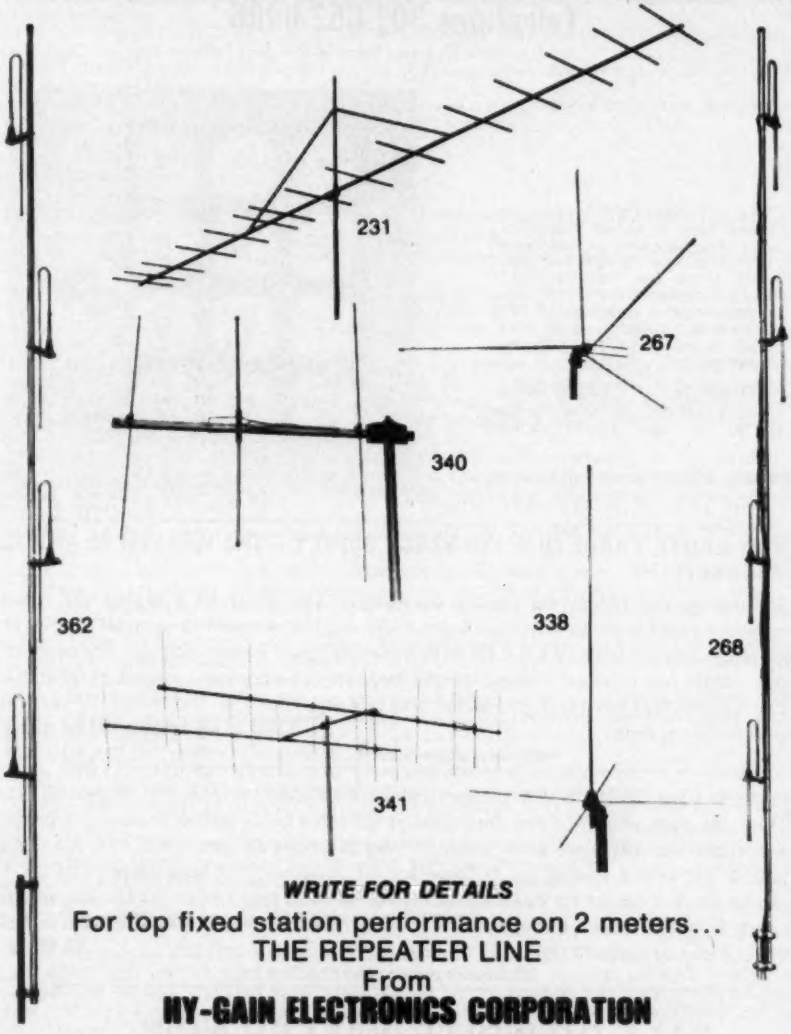

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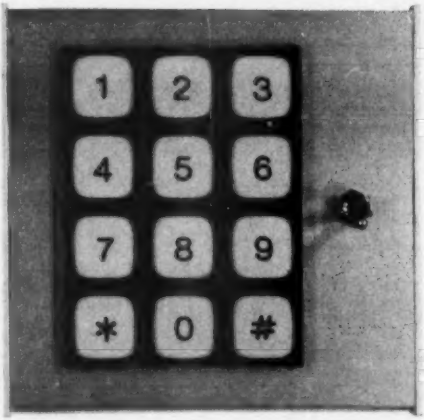

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ARC-34C, ARC-51BX, ARC-73, ARC-102, ARC-109, ARC-131, ARC-134, ARN-21C, ARN-52, ARN-65, ARN-67, ARN-74, ARN-82, ARN-83, COLLINS 618T, 618M, 51RV-1, 51Y-3, 51Y-4, 51R-8, 51X-2, 17L-7, WILCOX 807A, also need commercial test equipment by HP, TEKTRONIX, GENERAL RADIO, COLLINS, BENDIX, ARC. Will buy or trade for new ham gear.

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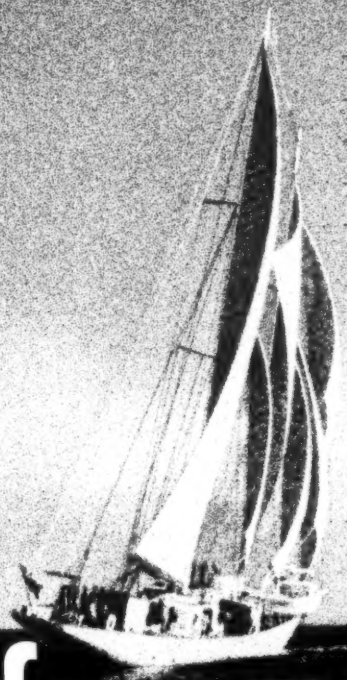

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88 or 44 mhy. Never potted — center tapped. Only 5 for $2.50 or 30 for $10.00 postpaid.*

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For all machines. Black nylon. 12 for $3.50 postpaid.*

tape
11/16" paper tape. FRESH. 40 rolls for $8.00.

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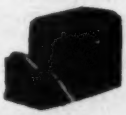

14 TD — $25.
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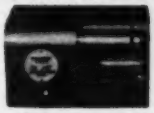

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Facsimile Transceiver — Sends and receives BIG 12" x 19" commercial quality picture. Can be adapted to receive weather maps and newsphotos

TXC1

fax paper
Pure white — high contrast electrosensitive paper. 12" x 19-1/2" for TXC1 — $4 per package of 250 sheets or $15 per case of 5 packages. All cut up and ream wrapped for Deskfax — $5 per 100 sheets.

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$25 Charge Minimum

STORE LOCATION
657 Valley Road
Gillette, New Jersey
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MOTOROLA OA442 TWO METER 1/4 KW Amplifier, new in factory ctns W/manual ... $350.00
NEMS-CLARKE 1670G VHF receiver ... $125.00
NEMS-CLARKE 1432 VHF receiver ... $135.00
DEFENSE ELECTRONICS IFT-1 PHASE LOCK TRACKING UNIT, 10mc if input ... $75.00
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MOTOROLA NPN 6012A ac power supplies, new ... $40.00
FARINON SS2000C Solid state microwave systems. Brand new ... P.U.R.
SECODE RPD 634 Digital decoders ... $15.00
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Parametric amplifier, 432mc–470mc. 20 DB gain, less than 2.0 DB noise figure. Very late design. Uses ferrite isolator & circulator. Mod. AIL 1789. 115v, 60cy. With instruction manual & schematic ... $150.00

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RD 142A 2 Channel, 24 hour tape recorders ... $29.95
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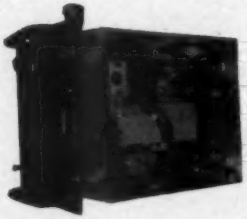
AM 1179/GRC
50–100mc converter. Modify to 144 or 220 in minutes. 30mc out. W/schematic, conv. info ... $28.00



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MOTRAC UHF Receiver strips, 440–470mc, like new ... $125.00

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BECKMAN 7175R Freq. meter ... $110.00

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HOLT Audio voltage standard AVS-321 ..... $350.00
POLARAD Mod. R Microwave receiver W/3 plug-ins $340.00
BECKMAN 3132/3 Programmer $85.00
SCIENTIFIC-ATLANTA 20MHz–100gc antenna pattern recording system. 1640APZ receiver, 1520 pattern recorder, 1554-2 crystal bolometer amp., 4100 ant positioner control, 5862 model tower on 5323-7 azimuth-over-elevation positioner. 2100, 2127, 2120, 2130 signal sources, 2128 BWO's & antennas. Additional information & prices on request.
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HEWLETT-PACKARD 524D Electronic counter with 525A plug-in $145.00
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(ALL SUPPLIES LISTED ARE 115vac, 60cy input)

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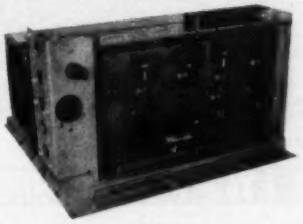
AC-DC ELECTRONICS
32944 . . . ±12vdc up to 8 amp out. Electronically regulated, short circuit proof. Brand new, factory sealed cartons. W/book & schematic $39.95



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SCHAUER 12458A Dual 5.6vdc (Reg) and 170vdc. Brand new $18.00
COMPONONT CORP. 12288B ±12vdc at 3 amp . . . New $9.95
NORTH ELECTRIC PEC 262B, 24/48/55vdc at 2 amp. Brand new. rack mt $25.00

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MUIRHEAD K300, K351, D900, K401, K221, solid state fax systems ..... Write

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DATA REPEATER, SOLID STATE, xtal control loaded with transistors, orange drop condensers and other usable parts. New $9.95
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TRANSISTOR AMP, PC board w/2ea 2N3739 xnstrs, diodes. 8 pin octal plug $1.50

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FM 2 Meter UHF 6 Meter USED

GENERAL ELECTRIC . . . RCA . . . MOTOROLA

General Electric Progress Line
2 Meter Mobile Units

14" case (less accessories & ovens)

MA/E33 6/12 volts,
30 watts, vibrator power supply

$98

MT/33 12 volts,
30 watts, transistor power supply

$178

G.E. PROGRESS LINE STRIPS physically complete, but sold on an as-is basis only.

	LOW BAND		VHF		UHF
	MA/E13	MA/E16	MA/E33	MA/E36	MA/E42
Power supply, 30W, less vibrator	$20	—	$20	—	$20
Power supply, 60W, less vibrator	—	$25	—	$25	—
TX narrow band, less final tubes Note: MA/E42 wide band	$18	$25	$25	$30	$12
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14" Progress Line Case, consisting of front basket and front plate with lock ..... $10.
Low band dual front end, 2 freq. strip ..... $20.
Hi-Band TPL RX with TX exciter strips less speaker, as is, missing parts ..... $25.

15,000 2-way FM mobile units in stock! Send for new 1973 catalog.

GREGORY ELECTRONICS CORP.

The FM Used Equipment People

243 Route 46, Saddle Brook, N. J. 07662

Phone (201) 489-9000 Dept 73

Catalog Number	Any Quantity Per Item (Mix) 1-99	100-999	Multiples of 10 Per Item (Mix) 1000 up	100-990
7400	.26	.25	.23	.22
7401	.26	.25	.23	.22
7402	.26	.25	.23	.22
7403	.26	.25	.23	.22
7404	.28	.27	.25	.24
7405	.28	.27	.25	.24
7406	.52	.50	.47	.44
7407	.52	.50	.47	.44
7408	.32	.30	.29	.27
7409	.32	.30	.29	.27
7410	.26	.25	.23	.22
7411	.28	.27	.25	.24
7413	.58	.55	.52	.49
7416	.52	.50	.47	.44
7417	.52	.50	.47	.44
7418	.26	.25	.23	.22
7420	.26	.25	.23	.22
7421	.26	.25	.23	.22
7423	.80	.76	.72	.68
7425	.50	.48	.45	.43
7426	.34	.32	.31	.29
7430	.26	.25	.23	.22
7437	.56	.53	.50	.48
7438	.56	.53	.50	.48
7440	.26	.25	.23	.22
7441	1.73	1.64	1.55	1.46
7442	1.27	1.21	1.14	1.07
7443	1.27	1.21	1.14	1.07
7444	1.27	1.21	1.14	1.07
7445	1.71	1.62	1.53	1.44
7446	1.24	1.17	1.11	1.04
7447	1.16	1.10	1.04	.98
7448	1.44	1.37	1.29	1.22
7450	.26	.25	.23	.22
7451	.56	.25	.23	.22
7453	.26	.25	.23	.22
7454	.26	.25	.23	.22
7459	.26	.25	.23	.22
7460	.26	.25	.23	.22
7470	.42	.40	.38	.36
7472	.38	.36	.34	.32
7473	.50	.48	.45	.43
7474	.50	.48	.45	.43
7475	.80	.76	.72	.68
7476	.56	.53	.50	.48
7480	.76	.72	.68	.65
7482	.99	.94	.88	.83
7483	1.63	1.55	1.46	1.38
7485	1.43	1.35	1.28	1.20
7486	.58	.55	.52	.49
7490	.80	.76	.72	.68
7491	1.43	1.35	1.28	1.20
7492	.80	.76	.72	.68
7493	.80	.76	.72	.68
7494	1.18	1.12	1.05	.99
7495	1.18	1.12	1.05	.99
7496	1.18	1.12	1.05	.99
74100	1.52	1.44	1.36	1.28
74107	.52	.49	.47	.44
74121	.56	.53	.50	.48
74122	.70	.67	.63	.60
74123	1.21	1.06	1.00	.94
74141	1.63	1.55	1.46	1.38
74143	1.41	1.33	1.26	1.18
74150	1.63	1.55	1.46	1.38
74151	1.20	1.13	1.07	1.01
74153	1.63	1.55	1.46	1.38
74154	2.43	2.30	2.16	2.03
74155	1.46	1.39	1.31	1.23
74156	1.46	1.39	1.31	1.23
74157	1.56	1.48	1.39	1.31
74158	1.56	1.48	1.39	1.31
74160	1.89	1.79	1.68	1.58
74162	1.89	1.79	1.68	1.58
74166	1.98	1.87	1.76	1.65
74176	1.62	1.53	1.45	1.36
74177	1.62	1.53	1.45	1.36
74180	1.20	1.13	1.07	1.01
74181	5.20	4.90	4.59	4.28
74182	1.20	1.13	1.07	1.01
74192	1.98	1.87	1.76	1.65
74193	1.98	1.87	1.76	1.65
74198	2.81	2.65	2.50	2.34
74199	2.81	2.65	2.50	2.34
SCHOTTKY TTL				
74S00	.88	.84	.79	.75
74S01	.88	.84	.79	.75
74S03	.88	.84	.79	.75
74S04	1.00	.95	.90	.85
74S05	1.00	.95	.90	.85
74S08	.88	.84	.79	.75
74S09	.88	.84	.79	.75
74S10	.88	.84	.79	.75
74S15	.88	.84	.79	.75
74S20	.88	.84	.79	.75
74S21	.88	.84	.79	.75
74S22	.88	.84	.79	.75
74S40	1.00	.95	.90	.85
74S50	.88	.84	.79	.75
74S51	.88	.84	.79	.75
74S60	.88	.84	.79	.75
74S64	.88	.84	.79	.75
74S65	.88	.84	.79	.75
74S73	1.82	1.73	1.63	1.54
74S74	1.82	1.73	1.63	1.54
74S107	1.82	1.73	1.63	1.54
74S112	1.82	1.73	1.63	1.54
74S114	1.82	1.73	1.63	1.54
74S140	1.00	.95	.90	.85
LINEAR IC'S				
NE501A	2.99	2.82	2.66	2.49
NE526A	3.59	3.38	3.17	2.95
NE531V	3.81	3.58	3.36	3.14
NE533T	3.81	3.58	3.36	3.14
NE536T	7.31	6.88	6.45	6.02
NE540T	2.16	2.04	1.92	1.80
SE540T	4.48	4.20	3.92	3.64
NE550A	1.24	1.17	1.11	1.04
NE560B	3.57	3.36	3.15	2.94
NE561B	3.57	3.36	3.15	2.94
NE562B	3.57	3.36	3.15	2.94
NE565A	3.57	3.36	3.15	2.94
NE566V	3.57	3.36	3.15	2.94
N5111A	.90	.86	.81	.77
N5595A	3.40	3.20	3.00	2.80
N5596A	1.87	1.77	1.66	1.56
709V	.42	.40	.38	.36
710A	.42	.40	.38	.36
711A	.44	.42	.40	.37
723A	1.00	.93	.90	.85
733A	1.90	1.80	1.70	1.60
741T	.44	.42	.40	.37
747A	1.05	.99	.94	.88
748V	.48	.46	.43	.41
LM335	2.85	2.72	2.64	2.55
LM336	3.85	3.66	3.46	3.27
LM337	4.05	3.70	3.51	3.31
TRANSISTORS AND DIODES				
1N270	.15	.14	.13	.12
1N914	.10	.09	.08	.07
1N4001	.10	.09	.08	.07
1N4002	.11	.10	.09	.08
1N4003	.13	.12	.11	.10
1N4006	.15	.14	.13	.12
1N747A thru 1N758A	.25	.22	.19	.16
2N3860	.25	.23	.21	.19

WHILE THEY LAST

LM101A	3.00	4.50	4.00	3.50	LM306	2.30	2.10	1.90	1.70
LM201	2.50	2.25	2.00	1.75	LM207	2.25	2.05	1.85	1.65
LM301	1.15	1.00	.85	.70	LM307	1.10	1.00	.90	.80
LM206	4.60	4.20	3.80	3.40	LM105	5.00	4.50	4.00	3.50

All IC's are supplied in 8-, 14-, or 24-pin DIP (Dual-in-line) plastic or ceramic package except for NE536, NE540, SE540, LM101A, LM201, LM301, LM206, LM306, LM207 and LM105 which come in TO-5 package. Voltage Regulators LM335, LM336 and LM337 are supplied in TO-3 (Diamond) package.

We give FREE data sheets upon request, so ask for those data sheets that you NEED, even for those listed IC's that you are not buying. On orders over $25.00 we'll send you a new 270-page COMPLETE TTL IC data book FREE. Or, you may obtain a new 240-page LINEAR data book instead. Orders over $50.00 will receive both books. Orders over $100.00 will receive a complete LIBRARY OF DIGITAL & LINEAR data & application books totaling 1,000 pages FREE. The above mentioned books are sent upon request only to avoid duplication. PLEASE NOTE: Data books are shipped separate from your order. Please allow two weeks for delivery.

LED 7-SEGMENT DISPLAY:

Litronix DL-10A 7-segment LED readout with ½" character height, improved brightness, left hand decimal point and an expected life of over 100 years. These are brand new with full data sheet and 4-page multiplexing application note.
Now also available in the larger OPCOA SLA-1 with 1/3" character height and the same features as DL-10A. Both fit in DIP sockets and are available in 1 overflow digit at the same price (Litronix DL-101A or Opcoa SLA-2). Mixing of regular and overflow digit allowed. NOTE: Needs a 7447 for driver and one current limiting resistor per segment.

INCANDESCENT 7-SEGMENT DISPLAY: With right hand decimal point. Rated 8mA per segment at TTL supply of 5V. Design life of 50,000 hours. Needs a 7447 as a driver. In DIP package.

	1-49	50-99	100-499	500-999	1000 up
DL-10A	4.95	4.75	4.50	4.25	4.00
DL-101A	4.95	4.75	4.50	4.25	4.00
SLA1	4.95	4.75	4.50	4.25	4.00
SLA2	4.95	4.75	4.50	4.25	4.00
Incandescent	3.25	3.00	2.75	2.50	2.25

Package of 8, ¼ watt current limiting resistors ..... $0.30.

MOLEX IC SOCKET PINS: Use these economical pins instead of soldering your IC's to PC boards. Sold in continuous strips in multiples of 100 pins only.

100 for $1.00	200 for $1.90	300 for $2.60	400 for $3.40
500 for $4.20	600 for $5.00	700 for $5.80	800 for $6.60
900 for $7.40	1000 for $8.20	each additional 1,000 $7.50	

Dual-in-line WIRE WRAP IC SOCKETS from SAE. Brand new with gold plated pins.

	1-49	50-99	100-499	500-999	1000 up
14 Pins	.65	.60	.55	.50	.45
16 Pins	.75	.70	.65	.60	.55

STANCOR TRANSFORMERS: Ideal for use with LM series.

P-8100, 25.2VCT, 1 amp $3.00
P-8134, 6.3VCT, 1.2 amp $2.75

HEAT SINKS: Wakefield series 680 circuit board coolers. 1¼" high with a dissipation up to 20 watts. Designed for use with TO-3 package.

	1-49	50-99	100-499	500-999	1000 up
Type 680-1.25A	1.20	1.10	1.00	.90	.80

ALLEN-BRADLEY MIL-GRADE (5-band) RESISTORS. Any of the 84 STANDARD 10% values from 2.7Ω to 22MΩ ¼ or ½ WATT. EACH ..... $0.05.

CERAMIC DISC CAPACITORS. Type 5GA-1000VDC:
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EACH ..... $.10
0.01μF. EACH ..... $.11 0.02μF. EACH ..... $.12

LOW VOLTAGE DISCS, Type UK.

1.0μF, 3V ..... $.25	2.2μF, 3V ..... $.30
.1μF, 10V ..... $.12	0.2μF, 10V ..... $.20
0.47μF, 3V ..... $.25	0.01μF, 16V ..... $.10

ELECTROLYTIC CAPACITORS: All values are available in both, axial or upright (PC Board) mount. Please indicate your choice.

10μF, 15V ..... $.10	1000μF, 35V ..... $.50
30μF, 15V ..... $.10	1μF, 50V ..... $.10
50μF, 15V ..... $.10	2μF, 50V ..... $.10
100μF, 15V ..... $.10	3μF, 50V ..... $.10
220μF, 15V ..... $.15	5μF, 50V ..... $.10
500μF, 15V ..... $.20	10μF, 50V ..... $.15
1000μF, 15V ..... $.30	20μF, 50V ..... $.20
20μF, 25V ..... $.15	50μF, 50V ..... $.20
30μF, 35V ..... $.20	100μF, 50V ..... $.20
50μF, 35V ..... $.20	200μF, 50V ..... $.40
100μF, 35V ..... $.20	500μF, 50V ..... $.55
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$ 0.00 - $ 4.99 add	$1.00
$ 5.00 - $24.99 add	$0.75
$ 25.00 - $49.99 add	$0.50
$ 50.00 - $99.99 add	$0.25
$100.00 and up	$0.00

SPECIAL CHARGES

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$19.95

Replaceable tips — Use ordinary solder — No cord to interfere — Ready to use instantly — Ideal to use on printed circuit boards, normal home and industry wiring repairs — Easily rechargeable — Place in separate recharging stand when not in use — Recharges from "dead" to "full charge" overnight.

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- ★Scope displays distortion on either received or transmitted signal
- ★Can generate a pre-distorted TTY signal for system performance analysis

Unit is checked out prior to shipping and shipped with all necessary instructions, schematics, and power supply data, less external power supply $55

Alden 419 precision fax machine – multiple scan rates and drum speeds, w/prec. ps $495
Airborne Inst. pwr osc, 200–2500mHz 365
Airborne Inst. prec rcvr, w/pre-amp 205
Ballantine 300 AC VTVM, 1 mv to 100v 45
Ballantine 305 (peak reading) 1mv to 1000v 125
Ballantine 700 sensitive inverter, 1 to 100v 85
Beckman 1452 digital recorder, 6 digit 140
Biddle megger, 10k ohm to inf. ins tstr 55
Boonton 160A Q mtr 50kHz to 75mHz 135
Boonton 170A Q mtr 30 to 200mHz 125
Boonton 190A Q mtr 20 to 260mHz 375
Boonton 207B univerter, 100kHz to 55mHz 105
Boonton 207E univerter, 100kHz to 55mHz 110
Borg 1526B Freq. standard, acc $1x10^{-9}$ per day outputs, 5,1,&.1mHz less emerg battery supply 395
Cohu 666 Thermal transfer standard 245
Dynatran ESL-1 diode test set 75
E.G.&G.707 Millimike 1gHz lab gp scope 525
Elec. Designs 180 Function gen (sim. to HP202A) 85
ESI SV194B Voltage calibrator 85
Empire NF105 w/T-2 field ints mtr 200–400mHz 1250
Englehard A Transfer standard AC-DC 250
Epsco VR607B Sec. volt std., .008 to 100v 230
Fluke 801R DC std. & null VTVM .05% 50 μv–500v 75
GR 546C Audio microvolter, dB scale, 600 Ohm 85
GR 724B Wavemeter, 16kHz–50mHz, .25% acc 45
GR 736A Wave analyzer, 10Hz to 16kHz 249
GR 760B Sound analyzer, 25 to 7500Hz, 1mv–10v 145
GR 821A Twin T imp. bridge, .46 to 40mHz 235
GR 1100AP Freq. std., contains 1101A, 1102A, 1103A .220
GR 1216A Unit IF amp., 30mHz 2 microvolt sens 110
GR 1231B Null det.&amp, w/P-5 filter & ps 70
GR 1302A Audio low distortion osc., .01–100kHz 125
GR1603A ZY bridge, 20Hz to 20kHz 176
GR 1610A Cap tst set, 1302A, 1231B, 716-P4, & 716C .525
Gertsch CRB28RB complex ratio bridge, 6-digit 685
HP 150A DC-10mHz scope w/152A dual trace vert. 185
HP 160B DC-15mHz scope w/166A, 162A dual trace 385
HP 185A DC-1gHz scope w/188B vert plug-in 335
HP 200ABR audio osc 35
HP 202B audio osc., .5 to 50,000Hz, 10v max out 75

HP 330C Audio distortion analyzer $225
HP 342A Automatic noise figure meter 245
HP 416A Ratiometer, fwrd/rev pwr ratio meter 165
HP 491A TWT amp, 2–4gHz, 1W 50 Ohm output 340
HP 524D Freq. counter, 10Hz to 10mHz 295
HP 526B Time interval plug-in 45
HP 540B Transfer osc, extends 524 to 12.4gHz 185
HP 560A Digital recorder 11 column 225
HP 571B/561B Dig. clock & 12 col. recorder 325
HP 608D (TS-510A/U) Sig gen, 10–420mHz 450
HP 610B Sig gen, 450–1200mHz, calib. atten 365
HP 616A Sig gen, 1.8–4.2gHz, FM, CW, pulse 385
HP 623B Microwave test set, 7152–7750mHz 695
HP 686A Sweep gen, 8.1–12.4gHz 10mW output 625
HP 803A VHF impedance bridge, 50–500mHz 195
HP 2590B Transfer osc & synchronizer, .5–15gHz 975
HP K01-738AR AC-DC meter calibration set 625
HP K25-99 Freq. standard-103AR, 113AR, 724BR, acc. $5X10^{-10}$ per day w/clock & sdby DC pwr supply 1225
Kay 880A Vari-sweep, 2–215mHz, calib. atten 175
Kay Mega-sweep Sweep gen, 50kHz–1000mHz 145
Kay Rada-sweep Sweep gen, 20–60mHz, 2 bands 115
Kay Rada-pulser 570A CW/pulse, 10–80mHz 195
Kintel 301 DC std/null VM, .01% acc, .1–501V 220
Lavoie LA-6 Freq. mtr, 100–500mHz, .001% acc 145
Nems Clark 1671 FM receiver, 175–260mHz 195
NLS 484A Digital DC VM, 4 digit, .01% acc 65
Peerless FA5299 ILS test set, mod freq. gen 145
Polarad R Microwave receiver, AM, FM, CW, MCW, pulse 400–84, 200mHz (write for plug-in details) 285
Polarad TSA Spectrum anal. (less plug-in) 325
Polarad SA-84W Wide disp. spec. anal, .01–64gHz 1260
QVS RAC777NC Ni-Cad cell & battery tester 30
RCA WV-84B Ultrasensitive DC microammeter 70
Rollin Std sig gen, 40–400mHz, up to 10W out 585
Sens. Res. ESH Electrostatic VM, 0–20kV 90
Sierra 121 Wave analyzer, 15–500kHz 215
Military Nomenclature:
ME 26D/U Mil. version of HP 410B VTVM 85
RD 142A Dual chan. 24hr tape recorder, 2" tape 145
TS 505D/U Gen. purpose VTVM, AC to 500mHz 65
TS 810/U Prec. calibrator, .1,1,10,100,1000kHz 45
USM 16 Std sig gen, 10–440mHz, AM, FM, sweep, pulse 675

(Send SASE for complete list.)

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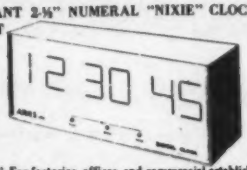
BRAND NEW CATALOG THOUSANDS OF SURPLUS BARGAINS

GIANT 2½" NUMERAL "NIXIE" CLOCK KIT



New! For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

Sh.Wt. 15 lbs.

With Case	GNNC/C	$98.50
Without Case	GNNC	$84.50

LOW-PRICED 6-DIGIT CLOCK KIT

New, low-priced digital clock with General Electric 7-segment numeric display tubes, in a styled walnut wood cabinet. In 1972, the B&F nixie display clock made history by being the first and only clock with electronic hours, minutes, and seconds display under $100. Now we have broken the $50 price barrier for 1973, and we doubt that anyone in the near future will be able to match this super-low price! This economy is made possible by a new large-scale integration chip, custom-designed for a six-digit clock. Clock has BCD output for external devices. May be wired for 24 or 12 hour operation with only a simple jumper change. Complete with all parts, sockets, instruction manual, and real wood case. Only a soldering iron and a screwdriver are required.

Sh.Wt. 5 lbs. LPDCW $47.50

SANKEN HIGH POWER, HIGH PERFORMANCE HYBRID VOLTAGE REGULATORS

These hybrid regulators are easy to use, requiring no external components. Excellent for operational amplifier supplies, logic supplies and other high performance applications. All regulators have less than 50 millivolts ripple and better than 1% line and load regulation, some models far exceeding this specification.

- ☐ SI3120E 12 Volts, 1 Ampere $2.25
- ☐ SI3150E 15 Volts, 1 Ampere $2.25
- ☐ SI3240E 24 Volts, 1 Ampere $2.25
- ☐ SI3050E 5 Volts, 1 Ampere $2.25
- ☐ SI3554M 5 Volts, 3 Amperes $7.00

WIRE-WRAP COMPUTER WIRE

New surplus from a large computer company. Solid silver-plated OFHC copper conductor. Special high-temperature, thin-wall insulation of teflon, and other quality materials. Extremely rugged and flexible wire-wrap wire. In addition to usual applications, can be used for effective breadboarding, and wherever quick stripping of solid wire is desired. Different colors are now available. State first, second, and third choice of colors. Shipping weight per 500' is 1 lb.

Conductor Size	Order No.	500'	1000'	10,000'
30	WWW30(ft.)	$5.00	$9.00	$75.00
26	WWW26(ft.)	$6.00	$11.00	$95.00
24	WWW24(ft.)	$6.50	$12.00	$100.00

ROTARY THUMBWHEEL SWITCH

Brand new digital switch, available with output in straight decimal form, or BCD. Widely used to set up predetermined counts or intervals, digital values or digital-to-analog values. Prices quoted are per section, or decade.

DECIMAL OUTPUT (10-position)	RTSDCO	$2.35
BINARY-CODED DECIMAL OUTPUT	RTSBCD	$2.35

HIGH-TEMP. POWER TRANSISTOR

2N1015D NPN Silicon 200W Power Amplifier 200V 10A $2.00
10 for $17.50 or 100 for $150.00

SANKEN HYBRID AUDIO AMPLIFIER MODULES.

We have made a fortunate purchase of Sanken Audio Amplifier Hybrid Modules. With these you can build your own audio amplifiers at less than the price of discrete components. Just add a power supply, and a chassis to act as a heat sink. Brand new units, in original boxes, guaranteed by B and F, Sanken, and the Sanken U.S. distributor. Available in three sizes: 10 watts RMS(20 watts music power), 25 watts RMS (50 watts M.P.), and 50 watts RMS. (100 watts M.P.) per channel. Twenty-page manufacturer's instruction book included. Sanken amplifiers have proved so simple and reliable that they are being used for industrial applications, such as servo amplifiers & wide band laboratory applications

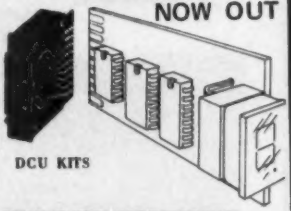
- ☐ SI1010Y 10 watt RMS amplifier, industrial grade $4.75
- ☐ SI1025A 25 watt RMS amplifier, industrial grade $14.75
- ☐ SII050A 50 watt RMS amplifier, industrial grade $22.50
- ☐ SI1025E 25 watt RMS amplifier, economy grade $14.00
- ☐ SI1050E 50 watt RMS amplifier, economy grade $21.00
- ☐ Transformer for stereo 10-watt amplifiers (2 lbs.) $3.95
- ☐ Transformer for stereo 25 or 50 watt amplifiers (5 lbs.) $5.95
- ☐ Set of (3) 2000 mfd 50V capacitors for 10-watt stereo $4.00
- ☐ Set of (3) 2200 mfd 75V capacitors for 25 or 50 watt amplifiers $5.00
- ☐ 4 Amp Bridge Rectifier, suitable for all amplifiers $2.00
- ☐ Complete kit for 100 watt RMS stereo amplifier (200 watt music) including two 50-watt Sanken hybrids, all parts, instructions, and nice 1/16" thick, black anodized and punched chassis $88.00
- ☐ Same for 50 watt RMS stereo amplifier, includes two 25 watt Sankens, etc. $58.00
- ☐ Same for 20 watt RMS stereo, includes two 10-watt Sankens, etc. $30.00

ELECTRONIC PRESET COUNTER

This counter is from a copying machine. It uses two Durant electro-mechanical decade counters, and includes a nice power supply, etc. Two rotary switches allow the unit to be preset with any number from 1 to 60. When the number of pulses in reaches this count, a relay opens, shutting off the controlled unit. Should be useful for coil winders, and other applications requiring shut-off at a predetermined count. The parts alone at our low price represent a "steal", as the unit has high quality switches, silicon rectifiers, transformers, etc.

☐ Preset Electronic Counter (6 lbs.) $6.75

NOW OUT



DCU KITS

DECADE COUNTING UNITS WITH READOUTS

Always one of B & F's most popular items, now revised to include drilled boards, I.C. sockets, and right-angle socket for readout. Arranged so that units can be stacked side by side and straight pieces of wire bussed through for power, ground and reset. Several different units are available as follows:

- 7490 Basic 10 MHz counter. Used in frequency counters and events.
- 74196 Same as 7490 except presettable 50 MHz unit. Used where higher speed and/or presettability is required.
- 74192 Bi-Directional Counter, 32 MHz operation. Has two input lines, one that makes the unit count up, the other down. Uses include timers, where the counter is preset to a number and counts down to zero, monitoring a sequence of events, i.e., keeping track of people in a room by counting up for entries and down for departures.
- 7475 Adds latch capability. Used in counter to displays continue displaying frequency while new frequency is being counted for uninterrupted display.
- 7447 Basic decoder module. Drives base seven segment display which is included for all modules.

NEWEST DCU!

This DCU combines all of the features of our other counting units, that is, high speed counting, up-down operation, storage, and preset. In addition it includes a comparator (7485) and a thumbwheel switch in order to provide comparison and preset capability. With this combination you can do the following:

1) Count up or down at speeds to 33 MegaHertz.
2) Store previous count during new count.
3) Preset to any number, count down for up) and generate a logic level when count of zero is reached. Stack several units and generate logic level for any count greater than zero.
4) Preset to zero, count up for down) and generate a logic level for any number greater or equal to the number preset in the thumbwheel switch. Stack several DCU's and generate a logic level showing whether number is greater than, equal to, or less than numbers preset on switches.

7490 - 7447 Counter	$8.25
7490 - 7475 - 7447 Counter	$9.25
74196 - 7475 - 7447 Counter	$10.25
74192 - 7447 Counter	$9.25
74192 - 7475 - 7447 - 7485 Universal DCU	$14.80

FUNCTION GENERATOR KIT

IMPOSSIBLE? A $700.00 function generator for $99.00? But true! The new, low-cost EXAR-205 monolithic waveform generator makes this price possible. Our kit uses two generator circuits -- one is a carrier generator, and produces sine, triangle, square, sawtooth, ramp and pulse waveforms. The second is a modulation generator, for amplitude or frequency modulation of the output waveforms. Output frequency range is from 20 Hz to 1.5 mega-Hertz. Modulation is switch-selectable for internal AM, internal FM, or external modulation.

Model AR-620K Function Generator $99.00

EPOXY RECTIFIERS

1 Amp	400 Volts	8 FOR $1.00
2.5 Amp	1000 Volts	4 FOR $1.00

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ALL ITEMS WHERE WEIGHT NOT SPECIFIED POSTAGE PAID IN THE U. S. A.

Phone in charges to (617) 531-5774 or (617) 532-2323. Bank Americard – Mastercharge. $15.00 minimum. No C.O.D.'s please.

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$10.00 Minimum Charge

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ARE PRICES ON ELECTRONICS COMPONENTS REALLY GOING UP? Of course, no one knows for sure, but we are of the opinion that they are. The recession in the electronics components business is truly over; sales are at a new record. Our, and other "independent distributors" ability to negotiate low prices because of manufacturers' overcapacity is greatly reduced. Many items, such as TTL devices, LED's, and MOS LSI are rationed. Our advice? Place your order now for a good stockpile of components while the hobbyist's paradise still exists.

WAVEFORM GENERATOR, BF-5
Just one of these BF-5 devices produces sine, square, triangle, ramp and sawtooth waveforms without additional active components. By adding a second BF-5, you can create amplitude, frequency or phase modulated varieties of these waveforms. They are able to replace large discrete waveform generators costing from $200.00 to $1300.00. At the same time, they greatly reduce system weight and power consumption. Full technical data, P.C. layout, assembly, and hook-up instructions included.

BF-5 WAVEFORM GENERATOR $9.75

GENERAL ELECTRIC PA-234,1.4-WATT POWER AMPLIFIER $1.25
This amplifier is housed in a plastic dual in-line package with a tab for heat transfer. Has only four active terminals, and requires only one capacitor for stabilization. Compatible with 8, 16, or 22-ohm loads. Applications include P.A. systems, phonos, movie projectors, TV, AM and FM receivers.

GENERAL ELECTRIC PA-265, 5-WATT VOLTAGE REGULATOR. Housed in plastic dual in-line package with staggered leads and power tab. Usable over wide range of input and output voltages, input voltages to 37 volts and outputs from 3 to 30 volts. Usable in a wide variety of circuits.

PA-234 POWER AMPLIFIER	$1.25
PA-258 VOLTAGE REGULATOR	$1.25

SUPER QUALITY I.C. SOCKETS
Sockets made by T.I. and Cinch. All are low-profile, compact types.

14 Pin Dip Solder Tale Sockets	
3 for $1.25	10 for $5.00
16 Pin Dip Solder Tale Sockets	
2 for $1.00	13 for $5.00
14 Pin Dip Gold Wire Wrap Sockets	
2 for $1.25	10 for $5.00
16 Pin Dip Gold Wire Wrap Sockets	
2 for $1.50	8 for $5.00
10 Pin To-5 Gold Sockets (Cinch)	
2 for $1.00	13 for $5.00

SINGLE CHIP 7-SEGMENT DISPLAY COUNTER, AND DECODER. That's right! A single chip TTL decade counter with latches, BCD outputs, a 7-segment decoder driver, AND a 7-segment LED display (with decimal) on top. Only 0.15" thick (not counting pins), the chip mounts in a standard 16-pin DIP socket. Digits are 0.270" high and can be latched in during the next count or blanked.

0.27 DLD $15.00

SPECTRA – STRIP FLAT BONDED
We know this is what everyone wants for their home-brew projects, because they always ask for it. We now have over 5 by 10^6 feet, but it won't last long, so order now before it's all gone. We don't want any broken hearts. Specs: 20 conductors, 24 AWG, 7 strands, size is .88" x .044". We could give all its virtues, but most people know them or could easily look it up in any industrial electronics house catalogue.

Sh. Wt. 1 lb./10 feet..., Order No. SSFBRC (ft.)
Price: $.35/1 ft. $1.00/3 ft. $5.00/18 ft.
$30.00/100 ft. $55.00/200 ft. $100.00/400 ft.
$200.00/800 ft. $500.00/2000 ft.

70 WATT RMS AUDIO AMPLIFIER BASIC PACKAGE. STEREO $6.50
Take advantage of Signetic's NE540 power driver, (class AB amp). Designed for 35 watts RMS per channel. Distortion .5% frequency response, ± .5db 20Hz to 100Hz. NE540 requires two power transistors, a 2N5296 (NPN) and a 2N6109 (PNP), supplied per NE 540. Kit package includes (2) NE540, (2) 2N5296, (2) 2N6109, information on P.C. board layout, parts and circuitry, and a list of miscellaneous small parts required to build the 70 watt amplifier for stereo.

☐ NE540		$2.25/ea.
☐ 2N5296	35 watt NPN	.75/ea.
☐ 2N6109	40 watt PNP	.75/ea.
☐ 70 watt Stereo Kit		$5.50/ea.
☐ 35 watt Mono Kit		$2.95/ea.

HARD-TO-GET DIGITAL I.C.'s — **SALE**

☐ 7447 BCD To-7 Segment Decoder Driver	$1.06
☐ 7490 Decimal Counter	$ .76
☐ 7485 Comparator	$1.25
☐ 74192 Up-Down Counter	$1.45
☐ RCA CD4001 Quad 2-Input Nor Gate (Cosmos)	$1.25
☐ RCA CD4007 Complementary Pair & Inverter	$1.50
☐ RCA CD4010 Hex Buffer	$1.50

MISCELLANEOUS SEMICONDUCTORS, SALE

☐ MUS 4988 Silicon Uni-lateral Switch. Useful for voltage-sensitive switch, sweep generators, etc.	$1.00
☐ MUS A65 PNP High-Current Darlington Transistor. Super high gain in a small package.	2/$1
☐ MPS A14, NPN, SAME AS ABOVE	2/$1.00

COMPACT BRIDGE

2 Amp	200 Volt	$ .60
2 Amp	400 Volt	$1.00
2 Amp	600 Volt	$1.50
2 Amp	800 Volt	$2.00
2 Amp	1000 Volt	$2.50
4 Amp	400 Volt	$1.50
4 Amp	600 Volt	$2.00
4 Amp	800 Volt	$2.50

PLASTIC FIBER OPTICS. Plastic optical monofibers are conveniently card-mounted and available in five different fiber diameters. Excellent supplement for B and F Fiber Optic Kits to provide additional fiber optic material. Fibers available in diameters of .005" (250 ft. card). Offer design versatility to R&D and product engineers. Specifications – maximum cont. oper. temp. - 170 degrees Fahrenheit, acceptance angle - 67 degrees, numerical aperture - 0.55, transmission range - 0.4 to 1.5 microns. YOUR CHOICE – $1.00

TIMER, 0 to 2.75 MINUTES GENERAL TIME. New packaged timers, for 115V, 60 Hz. Timer is set for 2.75 minutes (165 seconds) of operation. At the end of operating cycle, a SPDT switch is closed. May be reworked to provide any time delay between 0 and 2.75 minutes. Makes a useful lab or sequence timer. Latest design with current list price of $15.00

Sh.Wt. 1 lb. TGT $2.75 ea.
2TGT $5.00/2

SGS TAA 621 AUDIO AMPLIFIER
☐ I.C. audio amplifier in 14 pin DIP package, provides up to 4 watts power with proper heat sink, and 28 Volt supply. Can be used at 12 Volts with reduced output power. $1.95 ..... 6 for $10.00

LOGIC AND OPERATIONAL AMP' SUPPLIES

☐ Figure A, potted logic supply, 5 Volts at 1 Ampere, short circuit proof, ultra high regulation, ultra low ripple $16.00
☐ Figure A, potted Op Amp supply, +15 Volts, and -15 Volts at 0.5 Amperes. Mfg. by Analog Devices, similar to their model 902. Short circuit proof, ultra high performance $29.00
☐ Figure B, 5 Volt 1Amp supply, regulated by Fairchild 9305, short circuit protected. $9.75
☐ Same as above, in kit form $7.75
☐ Mating connector for above $1.00
☐ 5 Volt 5 Amp regulated supply, by Bluhyne, (not shown) $29.00

CALCULATOR CHIP SPECIAL!!!
One of the largest manufacturers of MOS Integrated Circuits has discontinued his three-chip set in favor of a single chip. This is the hobbyist's gain, since he can now obtain this fully tested, highly flexible set at a fraction of what even the largest calculator manufacturers pay. Consists of three 24-pin I.C.'s, has debounced input, eight-digit capacity, decoded seven-segment output. Full data included.

8-Digit Floating-Point Calculator Set $9.75

FAIRCHILD VOLTAGE REGULATORS
This is the UA 7800 Series. Three terminal regulator, with thermal overload protection and internal current limiting, making it essentially blow-out proof. Because simple circuitry is used with this device, designing regulated power supplies is dusk soup. Output is rated at 0 to 1 ampere; maximum input voltage is 35 volts. Choice of voltages: 5,8,8,12,15,18, or 24 Volts. Order as 7805, 7806, 7808, etc.

Voltage Regulator (Specify Voltage) $2.00

SHRINK TUBING. B and F has a truckload of shrink tubing, but we still expect it to go fast. If you have ever used shrink, you know it is indispensable for electronic construction. Made a wire too short? Just splice and shrink tubing over it and it will look like new. Pins too close? Same solution. Excellent results with hot-air gun, soldering iron, or even a match. This is polyolefin type where outer wall shrinks, inner wall melts to encapsulate wire.

SHRINK TUBING ASSORTMENT, 25 feet each, of 1/8, 3/16, 1/4-inch tubing $5.00

SPECIAL I.C.'S, PHASE LOCKED LOOPS

☐ NE560 Phase Locked Loop	$4.65
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☐ NE562 Phase Locked Loop	$4.65
☐ NE565 Phase Locked Loop	$4.65
☐ NE566 Function Generator/Tone Encoder.	$4.65
☐ NE567 PLL/Tone Decoder	$4.65
☐ NE595 Four Quadrant Multiplier	$3.75
☐ NE555 Timer, 2s Sec to 1 hour, Special	$1.25

[] Send $.25 for latest Catalog.

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Phone in charges to (617) 334-5774 or (617) 333-3335. Bank Americard – Mastercharge. $10.00 minimum. No C.O.D.'s please.

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P.O. Box 44, Fitchburg, Massachusetts 01420

ARIES

AIRCRAFT/AUTO/BOAT QUARTZ CRYSTAL CHRONOMETER

Revolutionary!, was the reaction of our customers when they saw our latest kit. Measuring only 3-1/2" x 3-1/2" x 4", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats and airplanes.

Fits into a standard 3-1/4" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e. replacing battery in car). The clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligable power drain. The low price is only possible because of a new one chip MOS clock circuit, developed for quartz crystal wristwatches.

Operates from 10-14 Volts D.C. An accessory unit which mounts on the back adapts the unit to 20-28 volts for twin engine aircraft and larger 1 sets using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

- ☐ Quartz Chronometer, Kit Form — $59.50
- ☐ Quartz Chronometer, Wired — $99.50
- ☐ 24 Volt Adapter — $10.00

DIGITAL CLOCK KIT WITH NIXIE DISPLAY

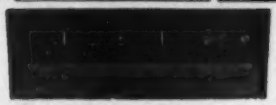
Because we have made an extremely good purchase of over 20,000 nixies, we can sell a complete digital clock kit for less than the usual cost of the display tubes alone. We provide a complete etched and thru-plated circuit board, all integrated circuits, complete power supply, display tubes, I.C. sockets and a nice front panel with polaroid visor. We have never seen anyone offer this kit for less than $100.00 before. Includes BCD outputs for use as with timer option. May be wired for 12 or 24 hour display. Indicates hours, minutes and seconds.

- ☐ Clock Kit, complete less outside cover . . . $57.50
- ☐ Aluminum blue or black anodized cover . . $4.50

AUDIO AMPLIFIER KIT

This is not our prettiest kit, but it sure does perform. Hybrid Sanken audio modules make wiring easy. Output ratings are maximum continuous at 1000 Hz with a distortion less than 0.5% into a load of 8 ohms. Response is ± 0.5 db 20-20K Hz @1 watt. Chassis supplied is heavy gauge anodized aluminum. Capacitors are all computer grade. Level controls on both inputs.

- ☐ 100 Watt (RMS) Stereo Kit — $80.00
- ☐ 50 Watt (RMS) Stereo Kit — $50.00
- ☐ 20 Watt (RMS) Stereo Kit — $30.00



50 MHz DIGITAL COUNTER LABORATORY SPECIFICATIONS AT A BUDGET PRICE!

We feel the most important thing about building a kit is saving money. There are a lot of other advantages of course . . maintainability, use of standard parts, complete documentation, and the experience and fun of building it, but the overriding consideration is economy. This kit costs less than half that of the lowest priced competitive unit on the market.

The Aries 50 MHz counter is designed for years of maintainence free service. MSI integrated circuitry, cold cathode display tubes and conservatively rated transformers mean low temperature rise. All displays and I.C.'s are in sockets for easy maintainability. The master oscillator is a 1.0 MHz crystal in a custom designed cosmos oscillator circuit, having a stability of ± 3 PPM. Accuracy is 0.005% worst case, 0.0002% or better when adjusted to WWV with a communications receiver. A front panel selects a timing interval of 1.0 seconds, 0.1 seconds or 10 milliseconds. A variable monostable multivibrator holds the count on the front panel for a period of a fraction of a second to infinity. For use in the period mode, the 1.0 MHz oscillator is connected to the main counting chain and gated by the input signal.

Assembly time for the kit is approx. 10 hours. The semiconductor complement is (1) 7400, (1) 7408, (1) 7442, (10) 7490, (2) 74122, (6) 74141, (1) 74193, (1) 74196, (1) 74511, (1) CD 4007AE, (1) LM308, (6) Diodes, and (1) Transistor. If you always wanted a laboratory quality counter, but could never justify the price, here is your chance.

- ☐ 50 MHz Counter Kit, Complete with Crystal Time Base and Case — Postpaid in USA $125.50

POCKET CALCULATOR

We expected a favorable reaction to our calculator, however, we were overwhelmed when we received orders for hundreds at a time. The reaction of our customers was that they felt this was the most advanced pocket calculator on the market, and priced so low, they could assemble and market it at a profit. The features that make this an exciting are:

- So compact it fits in a shirt pocket (3-13/16 x 4-5/8 x 1-1/4).
- Performs every function you would expect in a desk calculator, and then some, multiplies, divides, adds, subtracts and gives true credit balance. Includes constant and chain operation, full floating decimal, suppressed trailing zeroes, and automatic single entry squaring.
- Powered by self contained AA batteries with up to six hours operation (Nicad batteries with charger option, up to five hours per charge).
- Calculations performed by a single 40 pin LSI (large scale integration) chip. Displays are 8 digit LED's (light emitting diodes) and overflow and minus signs are also LED's.

As a student, engineer, salesman, accountant or anyone who would like fast accurate answers, this calculator fills the bill, and at a price that unquestionably makes this the lowest price high quality calculator available.

- ☐ Pocket Calculator Kit — $75.00
- ☐ Pocket Calculator Completed — $99.00
- ☐ NiCad Batteries & Charger — $17.50
- ☐ Batteries & Charger Completed — $25.00

16 DIGIT ELECTRONIC DESK TOP CALCULATOR KIT

Just one evening puts it together. Even if you have never assembled a kit before, our comprehensive step-by-step manual makes it easy. This calculator adds, subtracts, multiplies, divides - multiplies & divides by a constant. Has full 16 digit capacity with 8 decades of display and zero suppression. Entries and answers with greater than 8 digits can be displayed in their entirety in two alternate sections: the last eight digits and those digits exceeding eight. Negative results are correctly displayed, and an error symbol indicates an overflow beyond the 16 digit capability. Sequential operations can be performed using the answer to the previous operation as one of the entries for the next. The decimal point can be positioned following any of the eight least significant digits and will be carried automatically during subsequent operations. An additional good feature, concerning the beginner, is that all major components are in sockets, making troubleshooting easy. And if all else fails, (an unlikely occurrence) you can send it back to Aries and we will fix it for a maximum of $10.00, no matter what is wrong, having gross negligence.

- ☐ Kit - with Power Supply & Case $99.00

NEW FEATURE: CALCULATOR-TO-CLOCK CONVERTER

ARIES is now offering a special feature to convert our desk-top calculator into a clock. An additional chip keeps constant time while calculations are being made. Digital time readouts extinguish and operate silently during operations of calculator. A "must" for the busy executive. Available both with and without the calculator.

C/C CONVERTER with calculator..... $30.00
C/C CONVERTER separate order..... $25.00

LOW-PRICED 6-DIGIT CLOCK KIT!

Now, low-priced digital clock with General Electric 7-segment numeric display tubes, in a styled walnut wood cabinet. In 1972, the B4F nixie display clock made history by being the first and only clock with electronic hours, minutes, and seconds display under $100. Now we have broken the $50 price barrier for 1973, and we doubt that anyone in the near future will be able to match this super-low price! This economy is made possible by a new large-scale integration chip, custom-designed for a six-digit clock. Clock has BCD output for external devices. May be wired for 24 or 12 hour operation with only a simple jumper change. Complete with all parts, sockets, instruction manual, and real wood case. Only a soldering iron and a screwdriver are required.

Sh.Wt. 5 lbs. LPDCW $47.50

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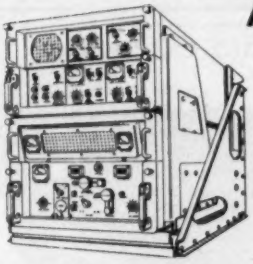
Please call factory for quantity prices

Save over $9,000.00 on this AN/WRR-2 SSB Receiver!



Original government cost: over $10,000.00! One of Navy's most modern radio receiving sets. Built by National Radio Co. in last decade. A triple conversion super-heterodyne. Frequency range: 2 to 32 MC. continuously, or in 1 kc increments. 4 bands. Featuring full carrier suppression, unit receives AM, CW, MCW, voice, facsimile, Teletype and ISB. REQUIRES NO MODIFICATION! Greatly superior to earlier R390A/URR model. Good cond. Complete, operational. Spec sheet available. Spare parts as needed

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Overhauled and certified . . . $595.00

Xerox copy of Operation Repair Manual: $35.00. Add $100.00 for 1/2 kc in lieu of 1 kc increments.

RADIO RECEIVER R-108/GRC Late model Army Comm. Recvr! 20—28 Mc. FM. Cont. or preset freq. OK for AM with simple modification. With schematic and hookup info. Like new. Smashing low price! $19.95
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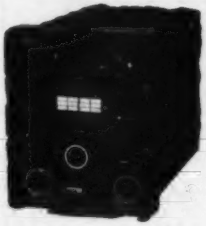

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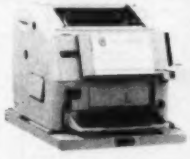

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This compact unit can be used with most Ham Receivers after conversion. Complete with conversion info and schematic. Good condition $19.95

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Just arrived! This collector's item is now available in new condition! 1.5 to 23 Mc. CW and AM. 50 watt CW. Ideal for a raft of multipurpose uses. Designed by Collins Radio. Brand new! A Columbia special $75.00

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R-748/TRC-47 single channel AM crystal controlled 110V 60CPS, pwr supply & speaker built in, squelch, r-f gain, dual conversion modern design. Size 19"W x 5"H x 14"D for rack mtg. Supplied with schematic & hookup info. No conversion required. Exl condition $29.95

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70—100 Mc. Single channel. 50 W. output.
110 V, 60 cycle. New and like new.
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The Time Machine *Electronic Clock Kit*

Step Into The Future With THE TIME MACHINE

Small Size: 2 1/4 X 4 1/2 X 6 3/4

BASIC CLOCK ELECTRONICS (KIT)	$45.50
HAND-FINISHED SOLID WALNUT CASE	8.95

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MANUAL RESET	.50
AUTO-POWER RESET	.95
SECONDS DISPLAY	1.00

Introducing the most stylish, compact, state-of-the-art electronic clock kit available anywhere.

THE TIME MACHINE utilizes the latest electronic techniques and advances to provide time information like no clock has before. A Large Scale Integration (LSI) circuit provides the logic to convert the 60 hertz line frequency into a displayable time. Internal options include a presettable alarm circuit, five minute snooze, and 24 hour time.

2-METER MARKER GENERATOR KIT

19.95

PROVIDES A MARKER SIGNAL ON ALL STANDARD 2-METER FM CHANNELS. INCLUDING THE REPEATER INPUT AND OUPUT CHANNELS AS WELL AS DIRECT CHANNELS.

Greatest advance in soldering since electricity...

- COMPLETELY PORTABLE
- HEATS IN 5 SECONDS
- SOLDERS UP TO 150 JOINTS OR MORE PER CHARGE
- RECHARGES AUTOMATICALLY IN ITS OWN STAND
- NO AC LEAKAGE OR INDUCED CURRENT TO DAMAGE DELICATE ELECTRONIC COMPONENTS.

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COMPLETE WITH RECHARGING STAND, FINE TIP AND INSTRUCTION BOOKLET

TOUCH CALLING KEYSET

A 12-button, alpha-numeric keyset equipped with a tone generator; identical to those used in Touch Calling telephones. The tone generator is mounted on a printed circuit card in back of the keyset. All tone frequencies are produced by a one-transistor oscillator.

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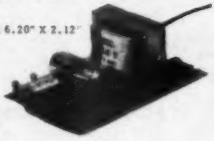
SIZE: 3.55" X 6.20" X 2.12"



5 VDC 3/4 AMP POWER SUPPLY KIT

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USES THE LATEST STATE-OF-THE-ART THREE TERMINAL REGULATOR CIRCUITRY.

HAS INTERNAL CURRENT LIMIT, THERMAL SHUTDOWN, AND SAFE-AREA COMPENSATION.

7 Segment LED Display

3.95 EACH NEW!

SIMILIAR TO MANSANTO MAN-1 AND OPCOA SLA-7. FITS IN 14 PIN DIP SOCKET.

DISPLAY KIT 1, INCLUDES: 7 SEGMENT LED, 7447, AND 7490. $ 5.95

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2 METER FM TRANSCEIVERS

MODEL IC-21

- 24 CHANNELS (WITH XTALS SUPPLIED FOR 7 CHANNELS).
- 10 WATTS OUTPUT.
- DYNAMIC MIKE.
- AC - DC OPERATION.

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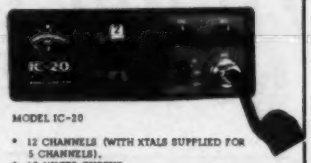

MODEL IC-20

- 12 CHANNELS (WITH XTALS SUPPLIED FOR 5 CHANNELS).
- 10 WATTS OUTPUT.
- DYNAMIC MIKE.
- 12 VDC OPERATION.

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$25.00 WORTH OF CATALOG MERCHANDISE WITH ALL CASH ORDERS.

ALPHA-NUMERIC KEYBOARD

$50.00

MICRO SWITCH

MODEL SW-10639 contains 61 #18W11 Solid-State switches including key tops, ROM encoded into EBCDIC.

MODEL RW-01135 contains 56 #7A1M3 Reed switches including key tops, diode encoded into EBCDIC.

MODEL 3916

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FOR 14 OR 16 DUAL-IN-LINE PACKAGES

The "Dip-Clip" is specially designed to allow the attachment of test probes to 14 or 16 lead DIPs. The unique design greatly reduces the possibility of accidental shorting while leaving the circuits illuminated. Numerous test probes may be quickly connected for hands-free testing.

MOS DIGITAL CLOCK CHIP

$14.95

Four digit electronic clock LSI circuit in 40 pin DIP. Designed for direct output to Liquid Crystal Display. Internal options include: Alarm, Snooze, Seconds Display, Reset, and 24 hour operation.

CREST POWER STRIPS

WITH: FUSE, SWITCH, AND LAMP

$9.30

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MODEL 11 Other Models Available MODEL 12

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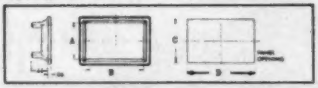
alpha-numeric display bezels



MODEL	DIMENSION 'A'	'B'	'C'	'D'	PRICE 1-24	25-99	100-UP
905-XX	.80	1.37	1.172	1.76	$2.25	2.07	1.91
910-XX	.80	2.00	1.172	2.37	2.30	2.12	1.95
915-XX	.80	3.00	1.172	3.37	2.40	2.21	2.04
920-XX	.80	4.00	1.172	4.37	2.45	2.25	2.08
930-XX	1.38	5.00	1.750	5.37	2.75	2.53	2.33
940-XX	.80	5.58	1.172	5.95	2.69	2.43	2.25
950-XX	1.38	6.50	1.750	6.87	3.15	2.89	2.67

WHEN ORDERING REPLACE XX WITH FILTER COLOR CODE:

NEUTRAL = 15, RED = 60, AMBER = 70, GREEN = 90

example: 950-60 (Model 950 with RED Filter)

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Deluxe Electronic Equipment Enclosures

MODEL	DIMENSIONS W.	H.	DEPTH	Screen Viewed	WEIGHT WT.
"A"	5½ x 2¼ x 5			no	3.75
"B"	5⅝ x 3⅜ x 7⅜			no	4.88
"C"	7¼ x 4⅜ x 8			no	6.00
"D"	9 x 3⅜ x 8 (double req. mat'l)			yes	9.75
"E"	8½ x 4⅜ x 7⅜			yes	8.38
"F"	7¼ x 6½ x 10			yes	9.00
"G"	10⅝ x 3⅜ x 9			yes	9.00
"H"	8½ x 6½ x 4			no	5.00
"EPC"	Wing Bracket set for "E"				.50
"HP"	"H" Panel with mounted Wide View meter, 3½"				10.50
"SW"	0-1 amp DC & 2 Rocker switches				
"SWP"	5 1/8 x 3 1/2 x 4 (Blank Panel)				5.95
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"M"	4 3/4 x 7 3/8 x 11 W/Handle				13.50
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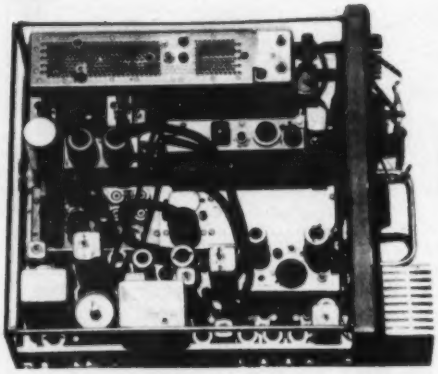

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Model MT 42 Mobile Unit 450 MHz
18 Watt Transistor Power
Supply with accessories $89
MT 42 Mobile Unit
less accessories $69
MT 42 Transmitter strip only ..$25
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MT 42 Power Supply $20

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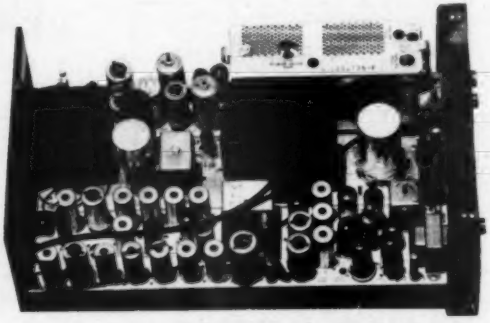
T43GGV Mobile Unit
less accessories $69
T43GGV Transmitter strip
TA139 only $20
T43GGV Receiver strip
TA140 only $35
T43GGV Power Supply
TU117 strip $10



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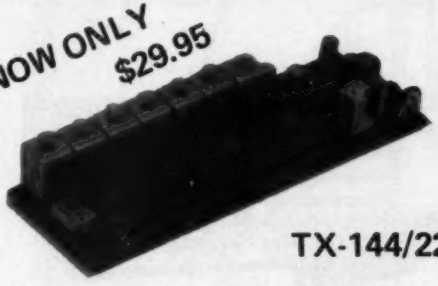
New lower quantity prices on RF power transistors allows us to offer the same quality transmitter for only . .**$29.95** . .

COMPLETE WITH DRILLED BOARD

NOW ONLY $29.95



TX-144/220

- TYPICALLY 1 1/2 WATTS OUTPUT AT 12.6 VOLTS (1 WATT ON 220)
- ADJUSTABLE DEVIATIONS TO 10 kHz
- AUDIO CLIPPING AND ACTIVE FILTER
- CRYSTAL NETTING TRIMMER
- DOUBLE TUNED RF STAGES FOR A CLEAN SIGNAL
- STANDARD 12 MHz CRYSTALS (14 MHz FOR 220)
- ZENER REGULATED OSCILLATOR
- PROVISIONS FOR METERING EACH RF STAGE
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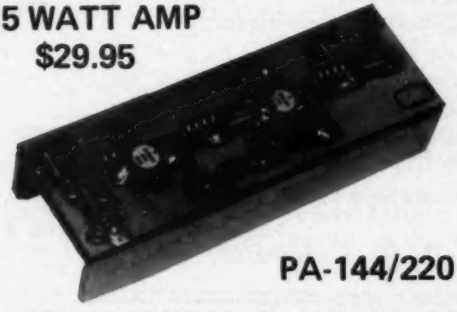
- MEASURES ONLY 2" x 6"

A one watt exciter using four RF transistors, two diodes, and one integrated circuit. The RF transistors are operating well below their ratings allowing long keying periods without damage. The exciter may be used alone as a transmitter or with our PA 144 or 220 amplifier for a fifteen watt station.

15 WATT AMP
$29.95



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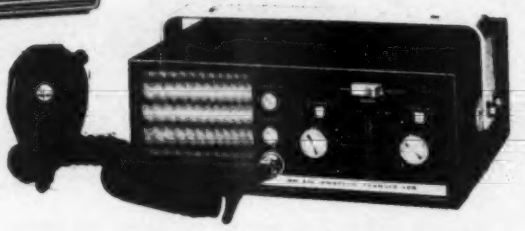

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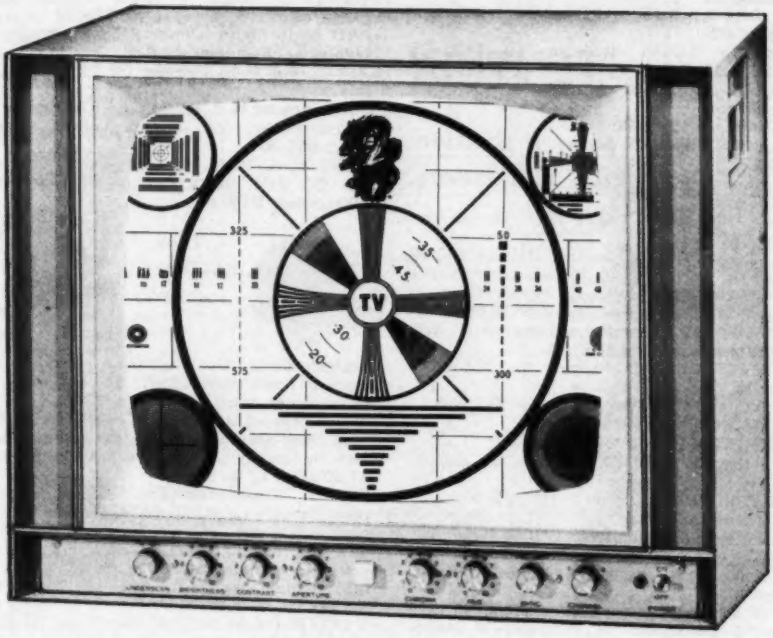

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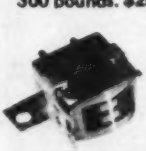

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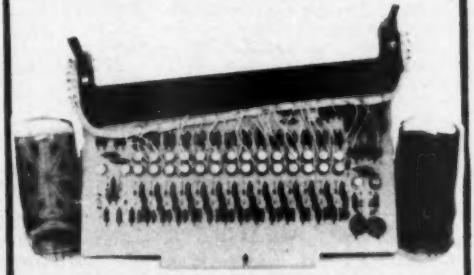

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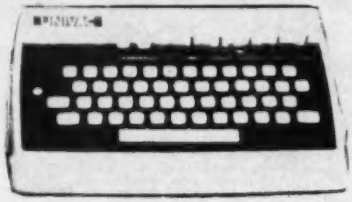

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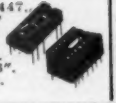

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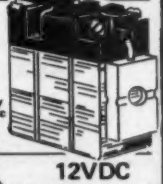

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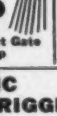

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SN7417	.48
SN7420	.25
SN7421	.25
SN7426	.32
SN7430	.25
SN7432	.25
SN7437	.50
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ADVERTISER INDEX *March, 1973*

Amat. Wholesale* 7,
☐ ARRL 105 106
ATV* 33
☐ Babylon 155
☐ B & F 144, 145, 146
☐ B & W 114, 129
☐ Bomar 29
☐ Camp Albert Butler 83
☐ Circuit Specialists 121
☐ Clegg 14, 38
☐ Columbia 147
☐ Command Prod. 106
☐ Cornell 106
☐ CushCraft 114
☐ Data Engineering 120
☐ Datak 22
☐ Densen 153
☐ Drake Cover II, 19
☐ D & T Enterprises 106
☐ Environ. Prod. 88, 89
☐ Estes 22
☐ Fair 114
☐ Gateway 80
☐ Glass 106
☐ Gray Electronics 143
☐ Gregory 140
☐ Grove Electronics 61
☐ Ham Radio Center 29
☐ Ham Shack 152
☐ Hamvention 105
☐ Harrison 113
☐ Henry Cover IV, 34
☐ Hobby Industries 114
☐ Hoisington 33
☐ Hy-Gain, 130–133
☐ Jan 80
☐ Jensen 106
☐ Jeff-Tronics 154
☐ Juge 124
☐ K A Sales 148, 149
☐ Kirk 3
☐ Mann 150
☐ Meshna 156, 157
☐ MFJ 33
☐ Miida 44
☐ Military Electronics 106
☐ MITS 119,128
☐ Morgain 105
☐ Newtronics 122,123
☐ Morgain 105
☐ New Haven Avionics 142
☐ Newsome Elec. 138, 139
☐ Palomar 83
Payne* 63
☐ Pearce Simpson 106
☐ Poly Paks 158, 159
☐ Regency 68
☐ Robot 25
☐ Savoy Cover III
☐ SBE 109
☐ Sentry 8, 76
☐ Slep 135
☐ Solid State 141
☐ Standard Comm. 37
☐ Telrex 84
☐ Thomas Elec. 57
☐ Valpey 13
☐ Vanguard 49
☐ Van W2DLT 137
☐ VHF Engineering 151
☐ Vibroplex 106
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				1	2	3
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	7A	14	14	14
ARGENTINA	14	7A	7A	7B	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7	7	14	14	7A	14	21
CANAL ZONE	14	7A	7	7	7	7	7A	14A	21	21	21	21
ENGLAND	7	7	7	7	7	7B	14	14A	14A	14A	14	7B
HAWAII	14	14	7B	7	7	7	7	7B	14	14A	21	21
INDIA	7	7	7B	7B	7B	7B	7B	14	14	7B	7B	7
JAPAN	14	7B	7B	7B	7B	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14A	21	21	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7B	7	14	14	7B	7A
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14A	14
SOUTH AFRICA	14	7	7	7	7B	14	21	21	21	21	14A	14
U. S. S. R.	7	7	7	7	7	7B	14	14	14	14	7B	7B
WEST COAST	14	14	7	7	7	7	7	14	14	14A	21	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	7A	7	7	7	7	7	7A	14	14	14
ARGENTINA	14A	14	7A	7B	7	7	7A	21	21	21	21	21
AUSTRALIA	21	14	14	7B	7B	7	7	7	14	7A	14	21
CANAL ZONE	21	14	7	7	7	7	7	14A	21	21	21	21
ENGLAND	7	7	7	7	7	7	7B	14	14	14	14	7B
HAWAII	21	14	14	7	7	7	7	7	14	14A	21	21
INDIA	7	7A	7B	7B	7B	7B	7B	7B	14	7	7	7
JAPAN	14	14	7B	7B	7B	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14A	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	7	14	14	7B	14
PUERTO RICO	14	14	7	7	7	7	7	14	14A	21	21	14A
SOUTH AFRICA	14	7	7	7	7B	7B	14	14	14A	21	21	14
U. S. S. R.	7	7	7	7	7	7B	7B	7B	14	14	7B	7B

WESTERN UNITED STATES TO:

ALASKA	14	14	7A	7	7	7	7	7	7	14	14	14
ARGENTINA	14A	14A	7A	7B	7	7	7B	14	14	21	21	21
AUSTRALIA	21	21	21	14	7B	7	7	7	14	7A	14	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	7	7	7	7B	7B	14	14	14	7B
HAWAII	21A	21	14	14	7	7	7	7	14	21	21	21
INDIA	7	14	14	7B	7B	7B	7B	7B	7	7	7	7
JAPAN	14A	14A	14	7B	7B	7	7	7	7	7B	14	14
MEXICO	21	14	7	7	7	7	7	14	14	14	21	21
PHILIPPINES	21	14A	14	7B	7B	7B	7B	7	7	14	7B	14
PUERTO RICO	14A	14	7	7	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	14	14	14A	14
U. S. S. R.	7B	7	7	7	7	7B	7B	7	14	14	7B	7B
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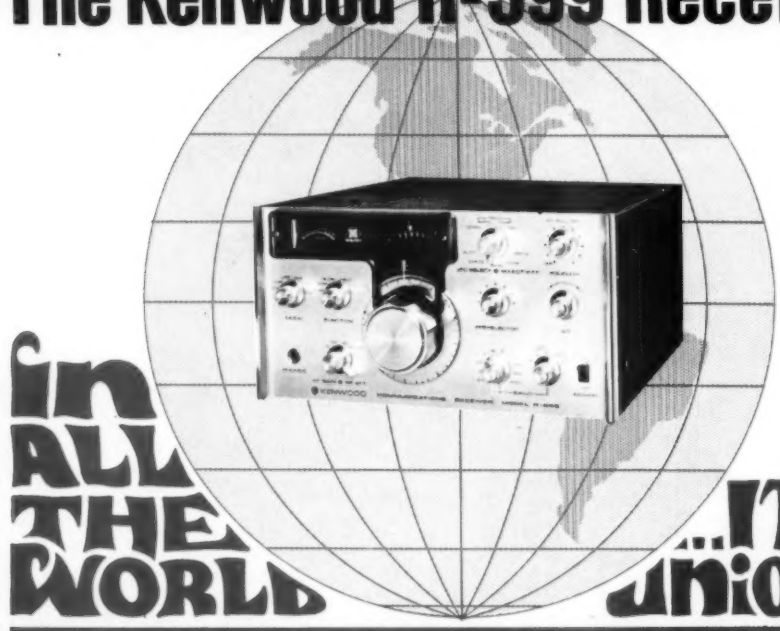

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The T-599 Transmitter: Clear, stable, selectable sideband, AM and CW • 4-way VFO flexibility plus Receiver Incremental Tuning (RIT) when used with the R-599 • Amplified ALC • Built-in VOX • Full metering, including cathode current, plate voltage, ALC and relative Power Output • Built-in CW Sidetone monitor and semi-automatic break-in CW • Built-in power supply • Maximum TVI protection • Employs only 3 vacuum tubes •
The price . . . $395.00

Another Kenwood value leader . . . the superb TS-511S Transceiver

Five bands, SSB and CW transceive. Built-in VOX, crystal calibrator, noise blanker, receiver incremental tuning, 1 KHz frequency readout, 8 pole filter, stable FET VFO, dual conversion and accessory CW filter. The price . . . $415.00.

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